INSTRUCTION MANUAL

MODEL 335

DIGITAL FUNCTION GENERATOR

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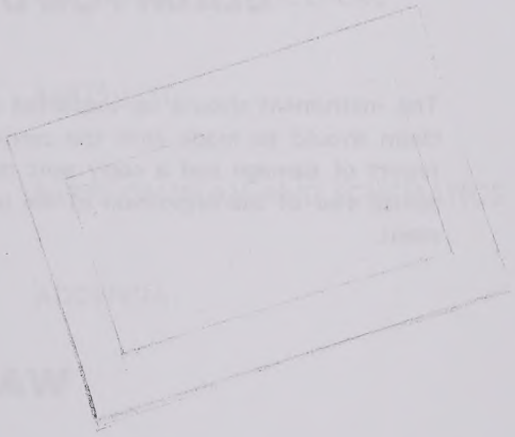

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IF YOUR INSTRUMENT DOES NOT OPERATE

PLEASE

1. Check operating procedure in manual for proper setup.

2. Check fuse and power supply voltages.

3. Call your Exact representative or factory. Instruments returned to the factory will be accepted only if they are sent freight prepaid, unless Exact or factory representative has authorized otherwise.

CLAIM FOR DAMAGED SHIPMENT

The instrument should be inspected as soon as received. If damage has occurred, a claim should be made with the carrier. The claim agent should receive a complete report of damage and a copy sent to Exact. After receiving this report, Exact will advise you of the dispostion of the instrument and arrange for its repair or replacement.

WARRANTY

Exact warrants its instruments to be free from defects in material and workmanship under normal use for a period of twelve months from the original date of shipment. Exact's obligation is limited to repair or replacement.

All repairs and replacements made under this warranty are f.o.b. Exact's factory or designated service depot unless otherwise authorized by Exact. This warranty is made on condition that prompt notice of defect is given to Exact, in writing, within the warranty period and that Exact shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any instrument which has been repaired or altered by other than Exact's own service representative so as, in Exact's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been operated contrary to sound practice or operating instructions.

CONTENTS

SECTION 1	SPECIFICATIONS AND VERIFICATION OF SPECIFICATIONS PROCEDURE
SECTION 2	OPERATING INSTRUCTIONS
SECTION 3	CIRCUIT DESCRIPTION
SECTION 4	CALIBRATION PROCEDURE
SECTION 5	PARTS LIST
SECTION 6	PARTS OVERLAY AND SCHEMATICS
SECTION 7	ADDENDA

SECTION 1

SPECIFICATIONS

AND

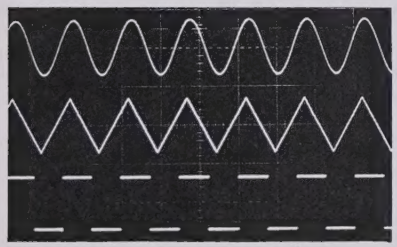
VERIFICATION OF SPECIFICATIONS PROCEDURE

NOTES

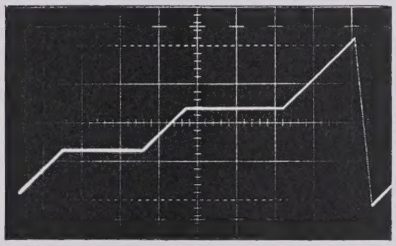
MODEL 335 DIGITAL FUNCTION GENERATOR

FEATURES

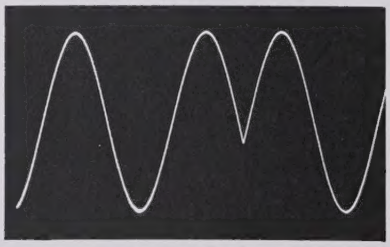
- DIGITAL SYNTHESIS OF ALL WAVEFORMS
- 0.02% AMPLITUDE STABILITY
- TRIGGERED AND GATED MODES
- FIXED AND VARIABLE DC OFFSET
- HOLD FEATURE ON ALL WAVEFORMS
- 0.00001 Hz (10μ Hz) TO 50 KHz FREQUENCY RANGE
- SINE, SQUARE, TRIANGLE, RAMP, PULSE, HAVERSINE
- VOLTAGE CONTROLLED FREQUENCY INPUT



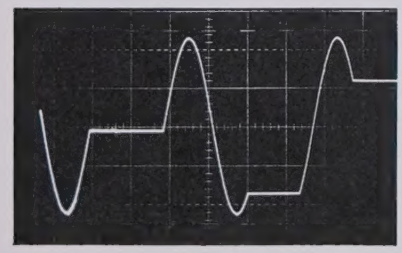
SINE TRIANGLE SQUARE



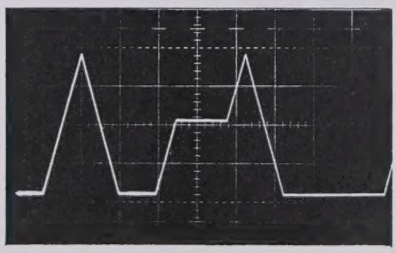
RAMP CAUGHT AND HELD TWICE AND ALLOWED TO COMPLETE THE CYCLE



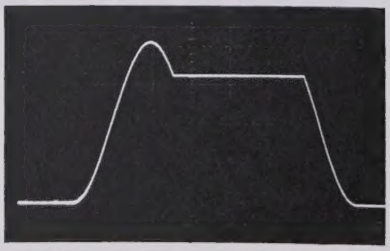
SHIFT QUADRANTS INSTANTANEOUSLY



SINE WAVE CAUGHT AND HELD AT THREE DIFFERENT POINTS



TRIGGERED TRIANGLE STARTED AT −90°, SECOND CYCLE HAS BEEN HELD AT ONE POINT



HAVERSINE HELD AT ONE POINT

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GENERAL

The Model 335 Digital Function Generator is a precision source of a wide variety of waveforms. Each cycle of every waveform is digitally synthesized using nearly 2,000 bits of digital information. This approach gives unparalleled control and stability of frequency and amplitude. All of the waveforms can be stopped and held at any one of the bits (allowing a ramp, as an example, to be stopped and held at a given level and then allowed to continue).

All the necessary waveforms are available to drive mechanical test systems, for geophysical and medical work, or for use as a general purpose laboratory tool. Trigger and Gating capability allows single shot, repetitively triggered or burst signals on all waveforms.

SPECIFICATIONS

WAVEFORMS: Sine, Square, Triangle, Ramp, Pulse and Sync.

DYNAMIC FREQUENCY RANGE:
0.00001 Hz (10μ Hz) to 50KHz
0.000001 Hz (1μ Hz) to 1KHz Optional

SYNC OUTPUT: Square wave approximately 4V P-P open circuit. 100-ohm output impedance.

FREQUENCY MULTIPLIER (Kelvin-Varley Divider) ACCURACY
$\pm$(1% of setting + 1% of range)

MAIN OUTPUT: 50 ohms output impedance
All waveforms $>$ 20V P-P Open circuit,
$>$ 10V P-P into 50 ohms.
A full 80db of attenuation is provided with 10db steps and 20db continuously variable.

VCF (Voltage-Controlled Frequency): Approx 5V input for 1000:1 (three decades) frequency ratio.

SINE WAVE DISTORTION:
$<$0.5% 0.00001 Hz to 5KHz
$<$1% to 50KHz

SINE FREQUENCY RESPONSE:
$\pm$ 0.1db to 1KHz
$\pm$ 0.25db to 50KHz

SQUARE WAVEFORM:
Rise and fall $<$1 microsec.
Overshoot and ringing $<$5%

TRIANGLE LINEARITY: 99% to 5KHz

D.C. OFFSET: $\pm$ 5V into 50 ohms, $\pm$ 10V open circuit. Note D.C. offset plus signal cannot exceed maximum voltage output or clipping will occur.

FREQUENCY STABILITY:
0.05% of setting for 10 min.
0.25% of setting for 24 hours.

AMPLITUDE STABILITY: (including hold mode)
0.02% of max P-P amplitude for 10 min.,
0.05% of max P-P amplitude for 24 hrs.

NOTE: All stabilities are for constant line voltage and temperature and do not apply in the Search mode of operation.

SYMMETRY (time): 99%

POWER REQUIREMENTS:
Input Voltage—115 VAC $\pm$10% or 220 VAC $\pm$10%
Frequency—50 to 400 Hz, Power Consumption 60W.

PHYSICAL CHARACTERISTICS:
17" wide x 3½" high x 13½" deep
Weight 11 lbs. net, 18 lbs. shipping.
Top and bottom covers easily removable, exposing all calibration and circuit board areas.

PRICE: (f.o.b. Hillsboro, Oregon)
1μHz to 1KHz Option

NOTE: (unless otherwise stated). Specifications apply from 10% to full amplitude with output terminated into 50 ohms and do not apply in the Search Mode. Specifications are valid at 25°C $\pm$5°C and with 105-125 VAC or 200-240 VAC line voltage applied.

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VERIFICATION OF SPECIFICATIONS

It is recommended that the instrument be operated with covers in place for a period of 1 hr. before verification of specifications.

The following test equipment or suitable equivalents of known accuracy are required for complete specification validation for the Model 335 Waveform Generator.

Oscilloscope
Tektronix 544 or equivalent
Differential Input with 5mv/cm sensitivity
Tektronix W Type Plug-in or equivalent
Counter-Timer, 50KHz - 100,000 seconds
Fairchild 8200 or equivalent
DVM, .01% accuracy with 1,000 meg ohm floating input
Fairchild 7000 or equivalent
Harmonic Distortion Analyzer, less than .1% residual distortion
Hewlett-Packard 333 or equivalent

Preset all the front panel controls as follows:

RANGE	1KHz
MULTIPLIER	1.00
FUNCTION	Square
AMPLITUDE	Fully Clockwise
ATTENUATOR	Disengaged
OFFSET	Disengaged
RUN	Engaged
GATE	Disengaged
MAN	Disengaged
START	Disengaged
HOLD	Disengaged
PEAK HOLD	Disengaged
1 SEC RESET	Disengaged

SPECIFICATIONS

FREQUENCY ACCURACY: To measure the frequency accurately all frequency measurements below I kilohertz are expressed in period time and all above in hertz. With the counter connected to main output:

Mult.	Range	Actual Setting	Accuracy	Generator should be within
1.0 X	.0001	.0001 Hz	± (1% of setting + 1% of Range)	10200 Sec. to 9800 Sec.
.10 X	.0001	.00001 Hz	"	111000 Sec. to 89000 Sec.
1.0 X	.001	.001Hz	"	1020 " to 980 "
.10 X	.001	.0001Hz	"	1100 " to 8900 "
1.0 X	.01	.01Hz	"	102 " to 98 "
.10 X	.01	.001Hz	"	1110 " to 890 "
1.0 X	.1	.1Hz	"	10.2 " to 9.8 "
.10 X	.1	.01Hz	"	111 " to 89 "
1.0 X	1	1.0Hz	"	1.02 " to .98 "
.10 X	1	.10Hz	"	11.1 " to 8.90 "
1.0 X	10	10Hz	"	.102 " to .098 "
.10 X	10	1.0Hz	"	1.11 " to .890 "
1.0 X	100	100Hz	"	10.2 ms to 9.80ms
.10 X	100	10Hz	"	111ms to 89.0ms
1.0 X	1K	1KHz	"	1.02ms to .980ms
.10 X	1K	100Hz	"	11.1ms to 8.90ms
1.0 X	5K	5KHz	"	4.90KHz to 5.1KHz
.10 X	5K	500Hz	"	.445KHz to .55KHz
1.0 X	50K	50KHz	"	49.0KHz to 51.0KHz
.10 X	50K	5KHz	"	4.45KHz to 5.55KHz

SINE DISTORTION: Return the Function Selector to Sine Wave and also check to see that generator frequency is set for 1 kilohertz. Amplitude Control should be set for mid range.

1. Connect Distortion Analyzer to the Output Connector terminated into 50Ω. Measure the sine distortion of less than .5% typically .2%.

2. Set the Range to 50K. Measure Sine distortion of less than 1%.

SINE FREQUENCY RESPONSE: Set the Range to 1KHz and connect the oscilloscope to the Output connector.

1. Observe sine wave amplitude.

2. Set Range to 50KHz. Observe sine amplitude drop less than .25db.

SQUARE WAVEFORM: Set Function Switch to Square. Set Amplitude Control for an output voltage of 10V peak to peak or less into 50Ω. Any voltage greater than this value could yield a rise time that is slower due to the slewing rate limitations.

1. Observe the rise and fall time to be less than or equal to 1 microsecond.

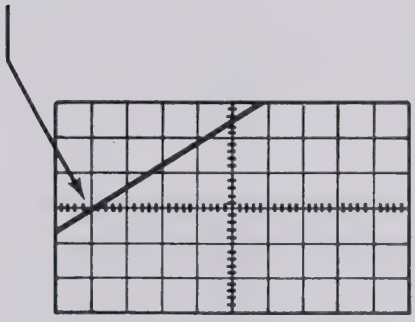
2. Observe that the overshoot and ringing are less than 5% of maximum peak to peak amplitude.

TRIANGLE LINEARITY: Set Range Switch to 1K. Set the Function Selector to Triangle. Monitor the Output Connector with the oscilloscope.

1. Adjust the oscilloscope to obtain 1/2 cycle of the triangular waveform across the full horizontal grid on the oscilloscope CRT.

2. Reset the Differential Plug-in to a sensitivity of 20 millivolts per centimeter.

3. Adjust the comparison voltage until the slope of the triangle waveform intersects the mid-scale horizontal grid line at the second major mark as shown below.



TRIANGLE LINEARITY: (Continued)

4. Record reference voltage using the DVM accurate to 1 millivolt.

5. Adjust the comparison voltage until slope of triangle intersects next major horizontal grid mark.

6. Record accurately the new reference voltage.

7. Repeat to obtain as many points as desired.

8. Calculate linearity and observe linearity is within specifications.

FREQUENCY STABILITY: Connect Frequency Counter to main output terminated into 50Ω. Measure frequency accurately. Note the frequency reading. Wait 10 minutes. Measure frequency again and note that frequency change should be less than .05%. Wait 24 hrs. Measure frequency again and note reading remains within .25%.

TIME SYMMETRY: Connect the counter timer to the Sync Output Connector on the front panel. Set the Range to 5kHz and set the Multiplier to 1.0. Set the Counter Timer to read time interval A to B and B to A. Observe the time symmetry error is less than 1%.

1. Set Range switch to 1K. Observe time symmetry error less than 1%.

2. Set Range to 100. Observe time symmetry error less than 1%.

3. Set Range to 10. Observe time symmetry error less than 1%.

4. Set Range to 1. Observe time symmetry error less than 1%.

AMPLITUDE STABILITY: Set Amplitude control to maximum, set Function to triangle, disengage Run. Connect output, terminated into 50Ω, to DVM and measure the positive and negative peaks by engaging the $\pm 90^{\circ}$ switches. Wait 10 minutes and repeat; observe output changes less than 1mv. Wait 24 hours and repeat. Observe amplitude changes less than 2.5mv.

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL FAMILIARITY (Figure 2.1)

1. Power switch
2. Pilot light
3. RANGE - selects frequency range
4. MULTIPLIER - varies frequency down from range setting. In search position, frequency can be varied through three decades below range setting.
5. FUNCTION - selects square, triangle, sine, pulse, ramp and all waveforms inverted.
6. AMPLITUDE - attenuates output over 20db.
7. D.C. OFFSET - controls offset voltage
8. TRIG LEVEL - sets voltage level between 1-15V that trigger the output.
9. SYNC OUT - provides square wave output coincident with peaks of waveforms.
10. VCF INPUT - input for external frequency control.
11. 1 SEC RESET - gives a reset time of one second independent of frequency.
12. PEAK HOLD - in trigger mode will hold waveform at peak until RESET pushed.
13. RESET - resets output when depressed momentarialy. Rate of reset will be normal unless 1 SEC RESET is depressed before RESET.
14. HOLD - holds the output until released or RESET depressed.
15. TRIG IN - allows external triggering.
16. START - sets lockout level at 0°, -90°, or +90°.
17. MAN - manually triggers output waveform.
18. GATE - output will free run when MAN is depressed or input at TRIG IN is above TRIG LEVEL setting.
19. RUN - output will free-run.

2.1 FRONT PANEL FAMILIARITY (Figure 2.1) Cont'd

20. OUTPUT - output 50Ω output impedance.

21. OFFSET-VAR - engages D.C. OFFSET level control

22. OFFSET-POS - shifts output level such that most negative point of waveform is at 0V.

23. OFFSET-INV. - shifts output level such that most positive point of waveform is at 0V. (POS must also be depressed.)

24. ATTENUATOR - allows for internal attenuation of the output.

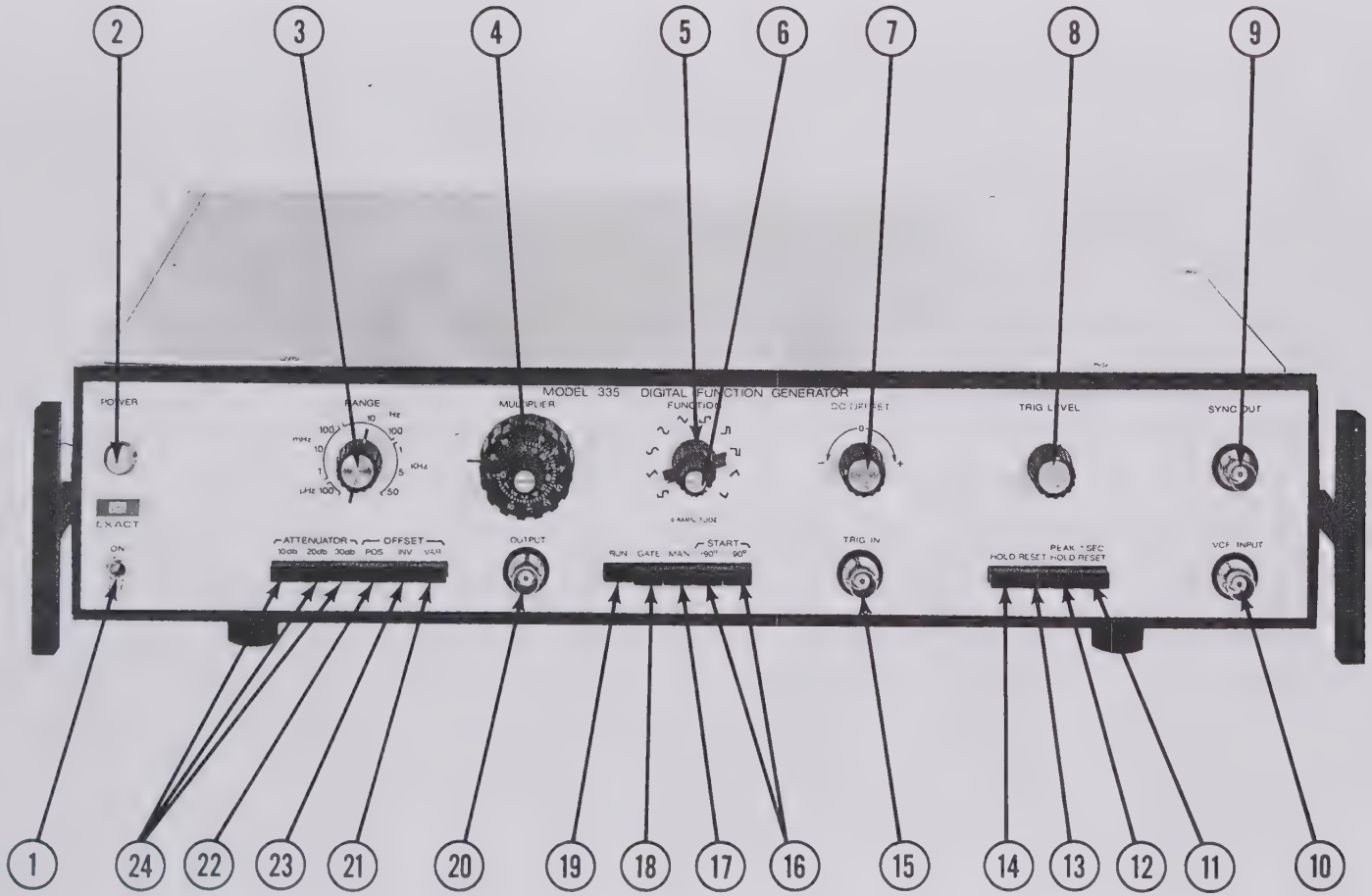


FIGURE 2.1 MODEL 335
FRONT PANEL FAMILIARITY

2.2 REAR PANEL FAMILIARITY (Figure 2.2)

1. FUSE DATA-shows requirements for operation at 115 or 220 volts.
2. FUSE HOLDER-allows easy replacement in the event of fuse failure.
3. LINE VOLTAGE SELECTOR-allows instruments to operate at 115 or 220 volts.
4. POWER CORD-accepts input power to instrument.
5. CIRCUIT COMMON-allows for floating operation of instrument.
6. OUTPUT-sames as front panel output.
7. SYNC OUT- same as front panel sync out.
8. EXTERNAL HOLD-allows for holding the output externally. (Holds on the negative portion of a square wave of at least -2 volts).
9. EXTERNAL OFFSET-allows for external DC offset. (1 volt in gives .3V offset).
10. TRIGGER IN-sames as front panel trig in.
11. VCF IN-sames as front panel VCF in.
12. EXTERNAL UP/DOWN- allows for externally controlling, direction of the output waveform. (A negative pulse of at least -2 volts will switch the direction).
13. EXTERNAL CLOCK-allows for external clock output. (4V P-P signal).
14. CLOCK SWITCH-controls whether clock is internal or external.
15. POWER SUPPLY PASS TRANSISTORS

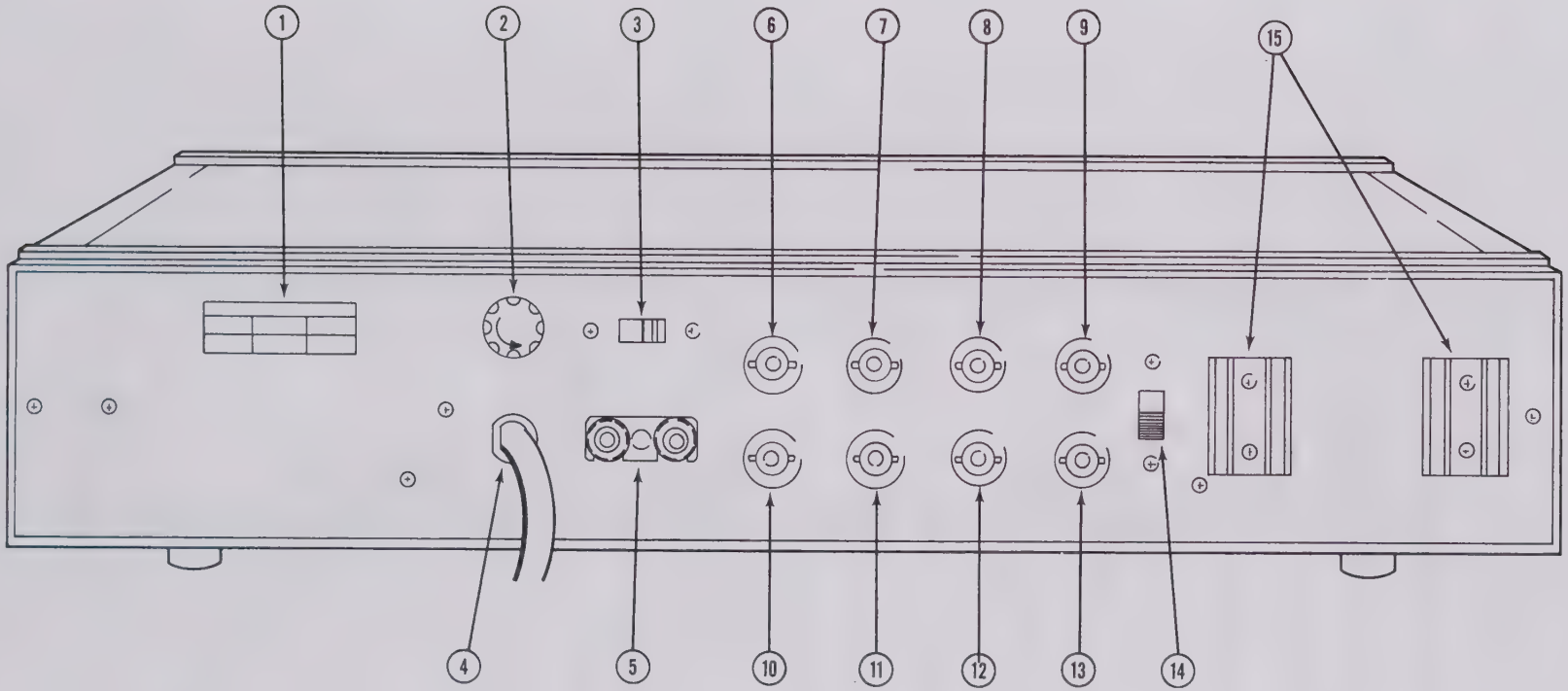


FIGURE 2.2 REAR PANEL FAMILIARITY

2.3 FIRST TIME OPERATION

BEFORE APPLYING POWER - set input power line switch, on back panel, to correspond to power source.

1. Plug into 115 or 220, 50-400 Hz.
   Set controls as follows:

POWER	on
RANGE	1KHz
MULTIPLIER	1.00
FUNCTION	triangle
AMPLITUDE	fully clockwise
ATTENUATOR	disengaged
OFFSET	disengaged
RUN	engaged
GATE	disengaged
START	disengaged
HOLD	disengaged
1 SEC RESET	disengaged

2. Connect output to scope, with 50Ω cable terminated into 50Ω. Observe triangle centered about ground 10V P-P.

3. Depress Attenuator switches and observe attenuation at output.

4. Depress POS - observe waveform, shifts such that peaks are at 0 and 5V. With POS depressed, depress INV. Observe waveform shifts such that peaks are at 0 and -5V.

5. Reduce amplitude by turning amplitude control counter-clockwise about a half a turn. Depress VAR. Rotate D. C. OFFSET and observe waveform D. C. shift. (at near peak amplitude the output will saturate varied over more than a few volts about 0.)

6. Release RUN and depress MAN momentarily and observe one cycle of the waveform starting at center of waveform. Depress $+90^{\circ}$ and depress MAN and observe one cycle of waveform starting at positive peak. Release $+90^{\circ}$ and depress -90° and observe one cycle starting at negative peak. Depress GATE and observe free running operation when MAN is held in.

7. Apply external triggering signal to TRIG IN. The TRIG LEVEL controls the triggering level from 1-15V. Observe output is triggered at external trigger frequency. Observe effect of START and GATE SWITCHES to be the same as in manual triggering (see above).

8. Set frequency to 1Hz and depress RUN. Depress HOLD and observe output holds. Release HOLD and observe output continues. Depress HOLD and observe that output resets when RESET is depressed. Depress RESET again and observe that output resets without holding first.

2.3 FIRST TIME OPERATION

9. Depress 1 SEC RESET, observe that reset is 1 sec independent of frequency setting.

10. Set RANGE to 1KHz and apply an external signal to VCF. Observe that frequency varies linearly with the input at VCF. Do not allow VCF input to set the frequency above 1.1 time the Range setting or 1/1000 of the range setting.
Note: with MULTIPLIER set at 1.1, the VCF input may go as low as -5.5V and no greater than 0V. As the multiplier is turned down these limits will shift upward. At multiplier setting of 0.1, the limits are at -0.5V and 5V.

SECTION 3

CIRCUIT DESCRIPTION

3.1 BLOCK DIAGRAM (Figure 6.1)

The clock, used to drive the logic circuitry, is produced by the generator loop composed of a positive and a negative current source which, respectively, charge and discharge the timing capacitor. When the voltage across the capacitor reaches 2V the level detector switches, switching in the negative current source to reverse the charging of the capacitor. At 0V the negative current source is switched out again. The frequency is controlled by the sum of the MULTIPLIER control and an external VCF signal. The resultant signal controls the output of the current sources and thus the frequency. The square out of the level detector is used as the clock.

Frequency range selection is achieved with logic circuitry, i.e. decade counters. The combination of the generator loop and the frequency dividing logic provides a clock which covers 8.5 decades. The 1 second reset is achieved by switching out the clock and switching in a separate oscillator which is independent of the MULTIPLIER and RANGE controls.

The counter circuitry is composed of three programmable, up/down, BCD counter which count the incoming clock pulses. The BCD outputs of the counters are converted, by a three decade digital to analog converter, into a triangle. The counters can be programmed such that the resulting triangle starts at -90°, 0°, or +90°. Count sensing logic senses the count of 899 when the counters are counting up and a count of 001 when they are counting down. This information is used to switch the direction of counting. The direction is not switched until after the next count to take propagation delay into account, thus insuring that the peaks are at 900 and 000 at all frequencies. The square wave from the up/down switch is used to produce the square wave at the OUTPUT and at SYNC OUT. The ramp reset and the 50KHz range are produced by inhibiting the first counter, thus there are 90 counts instead of 900. In the 50K range the second decade counter count sensing logic senses 1 instead of 0 on the down count so that the direction switches at the proper counts. The reset sensing logic determines when to switch to the ramp reset or the 1 second reset by sensing the reset counting direction regardless of starting direction. The clock run logic puts out a signal, when it is not running, which loads the counters to the start count and presets the up/down switch to insure that the counters start counting properly when control settings are changed.

Various modes of operation are controlled by switching the clock on or off. The output of the counters is compared to the programmed start count and when a coincidence is sensed, a pulse is sent to the clock-run logic which stops the clock, unless it is in the free run mode. HOLD simply inhibits the clock until the button is released. If PEAK HOLD is engaged the clock logic senses the pulse from the reset sensing logic and stops the clock at the peak. A pulse from either trigger source starts the clock. RESET will switch the count direction unless the counters are already reseting and will start the clock to override hold.

The output of the digital to analog converter is amplified and sent to the function selector. The function selector sends signals to the reset sensing circuitry and the up/down switch to cause phase inversion, activates the ramp reset control circuitry, and sends the triangle, sine and square to the preamplifier. D.C. Offset and attenuation is added to the output amplifier circuitry.

3.2 POWER SUPPLY (Figure 6.2)

The power line voltage is fed to the instrument through Plug P100 to the protective fuse F100. The line switch S101 supplies line voltage to the operating voltage selector S102. S102 applies the voltage to the transformer T100 in either a series or parallel arrangement depending on the line voltage available. The transformer is used to step down the voltages to lower values for application to the rectifier filter combinations in the instrument. Diodes D100, D101, D102 and D103 in combination with capacitors C100 and C101 supply an unregulated voltage of approximately +10V to supply the integrated circuit regulator Q110. Q110 is a complete power supply inside an integrated circuit package. It contains its own reference, voltage supply, and error amplifier. Q105 is an external series pass transistor used to enhance the current carrying capabilities of Q110. R105 is a current sensing resistor used to supply current limiting voltages to the integrated circuit Q110. Resistive divider R110, R111 and R112 is used to provide the necessary feedback voltage to the error amplifier inside Q110. R111 provides for a small adjustment in the value of the output voltage. Diode D110 prevents an external application of negative voltage to any of the circuitry on the +2.75V logic power supply lines.

Operational amplifier Q115 is used as an inverting amplifier with a gain of 1 to provide a -2.25V power supply that tracks very accurately the +2.75V power supply. The output of the operational amplifier drives the Darlington circuit made up of transistors Q120 and Q125. The output of the series pass transistor, Q125 is applied to the -2.25V line through current sensing resistor R130. Transistor Q130 is used to provide a feedback signal when current limit is reached. This feedback signal is applied to the input of the operational amplifier and reduces its output in the event of a current limit. Feedback necessary for closed loop operation is through R116, adjustment R118, and R117 to the +2.75V supply. Adjustment R118 is used to provide the small range of adjustment in the output voltage of the -2.25V supply. Diode D111 is used to prevent damage in the event of an application of positive voltage to the -2.25 line.

With all of the TTL logic and logic interface circuitry, etc. connected to the +2.75V and -2.25V power supplys, an overvoltage would be somewhat catastrophic; therefore, a completely passive "Crowbar" circuit has been installed. Any overvoltage on the power supply lines in excess of 10% will cause Q140, a silicon control rectifier, to conduct and remain conducting until the overvoltage has been corrected. The power switch must be turned off and then on again to restore operation. SCR Q140 receives its gate current drive from Transistor Q135. Transistor Q135 is operated as a saturated switch. It gets its base drive from the temperature compensating resistor network R139, R135, R136, R137 and R138.

Full wave diode bridge D104 along with filter capacitors C102 and C103 provides approximately ±30V for the regulators that regulate to +20V and -20V. Integrated circuit Q150 is a power supply unit that contains its own reference error amplifier, etc. Transistor Q145 is used to enhance the current carrying capability of the integrated circuit. Resistor R145 provides the current sensing so that the integrated circuit can be used to provide current limiting. Feedback voltage for the error amplifier in the integrated circuit is developed across voltage divider R151, R152 and R153. Adjustment R151 is used to provide a small amount of voltage adjustment for the +20V supply. Diode D150 provides protection against accidental application of negative voltages to the +20V power supply line. The +20V supply is used as a reference for the discreet component regulator that generates the -20V. Divider R172, R173 and R174 applies this reference to the differential amplifier made up of

3.2 POWER SUPPLY (Figure 6.2) Cont'd

transistors Q165 and Q170. The base of transistor Q165 is held at +3V by resistors R165 and R167. The output of the differential pair (which appears at the collector of Q165) is applied to the base of transistor Q175 through resistor R166.

Capacitor C175 and resistor R176 are phase compensating networks for the regulator. The output of transistor Q175 is applied to resistor R177 which in turn is connected to the base of the series pass transistor Q180. The emitter of Q180 supplies the necessary output current through current sensing resistor R181 to the power supply output. Transistor Q185 is used to provide a feedback signal to the differential amplifier Q170 through diode D185. This turns power supply voltage off in the event of a current limit signal which is developed across R181. Feedback necessary for power supply operation is through resistor R174 which maintain the reference to Q170 at +3V when both the power supplies are equal and opposite. Adjustment R173 provides for small amount of adjustment in the output voltage of the -20V supply. Diode D190 prevents damage in the event of application of positive voltage to the -20V power supply line. The provide a very stable +15V supply, the +20V from regulator Q150 is applied to integrated circuit Q160 and is re-regulated. Q160 is a complete power supply in one integrated circuit; that is, it has its own reference, error amplifier, etc. Transistor Q155 is used to enhance the current carrying capabilities of the integrated circuit. Resistor R155 is a current sensing resistor used to provide current limit operation of the integrated circuit. Feedback necessary for closed loop operation is through resistive divider made up of R161, R162 and R163. Adjustment R162 is used to provide a small amount of variation in the value of the supply voltage obtained at +15V supply output. Diode D160 is used to prevent damage in the event of application of negative voltage to the +15V power supply line. Operational amplifier Q190 is used as an inverting amplifier with a gain of 1 to provide a -15V power supply that tracks very accurately the +15V power supply. Diode D193 is used to shift the level of the operational amplifier to a higher voltage for operation of the Darlington circuit made up of transistors Q195, Q197. The output of the series pass transistor Q197 is applied to the -15V line through current sensing resitor R197. Transitor Q199 is used to provide a feedback signal when current limit is reached. This feedback signal is applied to the input of the operational amplifier and reduces its output in the event of a current limit. Feedback necessary for closed loop operation is through R190 adjustment R191, and R192 to the +15V supply. Adjustment R191 is used to provide the small range of adjustment in the output voltage of the -15V supply. Diode D191 is used to prevent damage in the event of an application of positive voltage to the -15V line.

3.3 FREQUENCY CONTROL CIRCUITRY (Figure 6.3)

The inputs to the VCF amplifier Q200 determines the frequency. The MULTIPLIER switch is wired as a Kelvin-Varley divider which also has a search position which allows the vernier potentiometer to sweep the entire range of the frequency control circuit, that is 1000:1. An externally applied VCF input is the other frequency control input to the VCF amplifier. There is a third input from the Search Range potentiometer, R228, which forms part of the voltage divider R227, R228, R229. This input prevents the frequency from

3.3 FREQUENCY CONTROL CIRCUITRY (Figure 6.3) Cont'd

going to zero and is adjusted for a lowest frequency of 1/1000 of the frequency range. The VCF BAL potentiometer, R225, adjusts the internal D.C. Offset at Q200. Diodes D220 and D221 limit the voltage input.

3.4 CLOCK GENERATOR (Figure 6.4)

The level shifting amplifiers tied to the output of the VCF amplifier are voltage controlled current sources which provide equal and opposite voltage to drive the current sources. Q230 and Q235 form the positive level shifter. Q230 is driven from the inverting input, Q235 forms a buffer for the output of Q230 resulting in a high output impedance. Pos Drive Bal potentiometer, R232, allows for balancing the internal D.C. offset in Q230. The negative level shifter, Q250, and Q255 operates in a similar manner, but Q250 is driven from the non-inverting input, with R250 being used to balance D.C. offset.

The positive and negative current sources are driven from the level shifters. Q240 and Q245 form the positive current source. Operational amplifier Q240 is driven from the non-inverting input and the emitter voltage at the emitter follower, Q245, is fed back to the inverting input of Q240. The output current of the current source is controlled by the voltage at the emitter of Q245, which is the same as the input voltage at Q240. The input voltage varies from 10-15 volts. Positive Current Balance R241 provides for balancing the offset in Q240. The negative current source, Q260 and Q265, operates in a similar manner. The positive current source is connected directly to the timing capacitance C245, C246, and C247. The negative current source is connected to the timing capacitance through the diode switch D265 and D266, which is controlled by the level detector. When switched in, the negative current source pulls enough current to cancel the positive current source and drain charge from the timing capacitance. The resulting triangle is fed to the buffer, Q270 and Q275. Field effect transistor, Q270A, provides a high input impedance for the triangle. Q275A then provides a low output impedance to the level detector. Q270A and Q275A have matched counterpart, Q270B and Q275B, which get the offset in the buffer at 0V by insuring that the base emitter drop of Q275A equals the source-gate drop in Q270A. C277, C278, R282 and R277 form a voltage divider and high frequency lead network, which compensates for the high frequency response of the level detector. Q295 forms a constant current source providing operating current for the matched differential pair Q280. Q280 compares the triangle voltage to a reference voltage across R282. D280 and D281 clamp the collector voltage to insure current mode operation exists for high speed. Q290 and Q285 provide a square wave which is clamped by D285 through D292. This square wave drives the diode switch D282 and D283 to change the reference voltage, thus creating positive feedback, necessary for level detector operation. The square wave also drives the negative current source diode switch thus forming a closed loop around the current source and level detector.

3.5 CLOCK DIVIDER CIRCUITRY (Figure 6.5)

The 1SEC RESET oscillator is of the relaxation type. When the voltage across capacitor C380 reaches the peak point voltage of the unijunction transistor Q380 the emitter is forward biased and C380 is discharged through R393. This forms a sawtooth at the base of Q395. Q395 acts as a switch to convert the sawtooth into a square wave with levels compatible with the logic. The 1 Sec Reset Adj, R390, allows for adjusting the frequency to 900Hz.

Q310A acts as a buffer between the level detector and Q300. Decade counter, Q300, is wired to divide by 5 for all but the top two frequency ranges. Q320 through Q350 are decade counters wired for symmetrical divide by 10 operation. Q355 is a data selector with data inputs from the decade counters and BCD selector inputs from the RANGE switch. The output of Q355 is a square wave variable over 8.5 decades. The 1 SEC RESET switch presents a control signal to Q360B and Q355, which disables the output of Q355 and allows the output of the 1 SEC RESET oscillator to take the place of the clock during reset. Q310D senses a 9 from the RANGE switch, which, along with the inverted square wave from the 1 SEC RESET switch is sent to Q360D to be used in the counter (see Sec. 3.6).

3.6 CLOCK CONTROL CIRCUITRY (Figure 6.6)

The clock is fed to Q375, which insures that, when a trigger pulse from Q370 appears at Q375A and Q375B, the first clock pulse to be sent to the counter circuit will not be too short to operate the counters. A short pulse coincident with the rise of the clock pulse is allowed through Q375B after the trigger pulse appears. This switches the RS flip-flop formed by Q375A and Q375C and allows the clock through Q375D. The flip-flop is reset and the clock stopped when the trigger pulse from Q370A goes low.

Q370A and Q370B form an RS flip-flop, which determines when the clock runs. Any low level input of Q370A starts the clock and a low level input to Q370B stops it. All inputs except RUN and GATE are A.C. coupled with the normal state being high. When RUN is engaged, an input of Q370A is held low thus any pulse applied to Q370B will be ignored. HOLD drives another RS flip-flop, Q365A and Q365B, which prevents switch noise from the falsely triggering Q370. When HOLD is engaged the low level run input to Q370A is set high and a low level pulse is sent to Q370B through capacitor C369 which stops the clock. When HOLD is released the circuit goes back to its original state and the clock starts. If RUN is not depressed, a pulse through C365 will start the clock when HOLD is released. MANual trigger and RESET are wired to an RS flip-flop, Q497A and Q497B to get rid of switch noise. The output of Q497A is A.C. coupled through C497 and sent to Q370A, thus a high to low level transition from Q497A will start the clock. (RESET also has another control function in the counter circuitry.) (See Sec. 3.6).

C497 is bypassed when GATE is engaged, so the clock will run as long as MAN is depressed. The TRIG IN external trigger input is fed to a differential comparator, Q390. The level of the trigger signal is compared to the TRIG LEVEL voltage and, when it is greater, trips the comparator. The positive feedback loop around Q390, through R387, prevents noise from falsely

3.6 CLOCK CONTROL CIRCUITRY (Figure 6.6) Con't.

triggering the comparator. The output is inverted by Q305B and then sent to Q305C. If PEAK HOLD is not engaged, the pulse reaches Q370A and starts the clock. If PEAK HOLD is depressed, the trigger signal can only get through after a reset. The count coincidence pulse from the counter circuitry (see Sec. 3.6) is applied to Q370B. It will stop the clock unless RUN, or GATE and a trigger pulse, are holding an input to Q370A low. The input from the counter to Q497C is a square wave which is high during a reset, thus, if the output of Q365C is high and PEAK HOLD is depressed, a pulse will reach Q370B to stop the clock at the start of a reset. Q365C and Q365D form another RS flip-flop. The input to Q365C is the count coincidence pulse. The input to Q365D is the reset signal from the counter. (See Sec. 3.6). This is necessary to prevent the clock from stopping after reset is depressed when PEAK HOLD is engaged. PEAK HOLD will not work in RUN because RUN holds an input to Q370A low. Q400A and Q400B form another RS flip-flop which sends a signal to load the counters whenever the clock is turned off by a count coincidence only. This allows the ±90° switches to operate.

3.7 COUNTER CIRCUITRY (Figure 6.7)

The Counting is done by three programmable, up/down, BCD counters Q410, Q445, and Q465 cascaded to count through three decades. The clock, from Q375, is fed to pins 14 of the counters. Pins 1, 15, 9 and 10 are the BCD programming inputs which receive information from +90° and -90° switches to program counts of 0, 450, or 900. The inputs to the second and third counters are loaded when a low level signal is received from Q430A at pins 11. The loading of the first counter Q410 is complicated because during a ramp reset or in the 50KHz range the counter is disabled. Information from Q360D and Q400B from the clock control circuitry and ramp reset and 50K range signals from the function and range switches are analyzed at Q405A, Q493A, Q493B and Q405C such that the first counter will be disabled and loaded to 0 during a ramp reset and in the 50KHz range unless 1 SEC RESET has been engaged, in which case, the counter is not disabled during the reset. The up/down line to the first counter is set high when the counter is disabled so that the output fed to the second counter is high, thus enabling it to count. Q440A and Q420A sense a count of 1 in the first counter, Q410. The min/max output serves as count of 0. Q460A and Q470A sense a count of 1 in the second counter, Q445, the min/max output serve as counts of 0 and 9. Q460B, Q460C and Q460D determine whether the count of 1 or 0 is used. The 1 count is used only in the 50KHz range so that the count will be from 0-90 in that range. Q-440B and Q470B sense a count of 8 in the third counter, Q465. The min/max output of Q465 is used as a count of 0. The count sense line go to Q480A and Q480B. At the output of Q480C there is a pulse at counts of 001 and 899 or, when the first counter is disabled, 01 and 89. This pulse is sent to Q485A and also acts as the clock pulse to switch the outputs of Q485A after being delayed through Q440C. The clock is inverted through Q430B and is used to clock Q485B. The outputs of Q485B are switched at the beginning of the 0 and 900 counts

3.7 COUNTER CIRCUITRY (Figure 6.7) Cont'd

and is sent to the counter to switch the count direction. The output is also used to drive the sync out buffer, Q600 and Q605, and the square switch. (see Sec. 3.7). Q430C and Q430D are connected to the clear and preset inputs of Q485 to preset the direction of count as determined by the condition of the ±90° switches and the 180° phase shift signal from the function switch. The RESET switch is connected through an RS flip-flop, Q493C and Q400C, to take care of switch noise. Q493D disables the flip-flop during a reset and immediately after the flip-flop has switched to prevent the signal to Q493D pin 1 from falsely switching the flip-flop if the switch is held in longer than the reset time. The reset pulse is sent to Q480C to switch the counting direction and to the clock control circuitry to prevent PEAK HOLD from stopping the clock.

The inputs and outputs of Q410 are connected to Q415 and from there to Q420B. A pulse appears at the output of Q420B whenever the output count reaches the programmed input count. The same logic is used on the second counter with Q450 and Q455A and on the third counter with Q475 and Q455B. These three signals are sent to Q495B along with a fourth bit of information from Q497D which is the output of an exclusive or function, formed by Q490 and Q497A, that is performed on the up/down signal and the 180° phase shift signal. The output of Q497D is high anytime the up/down signal is in the state it was in when the clock started. Thus the output of Q495B gives a pulse at the end of each cycle and is used in the clock control circuitry to stop the clock and load the counters. The input and output of Q497D are also used to determine when to peak hold and 1 second reset. (see Sec. 3.5).

3.8 DIGITAL TO ANALOG CONVERTOR (Figure 6.8)

The BCD output of the three counters are sent to the D/A converter. The least significant decade is converted by the diode switches D500 and D507 and their associated resistive current sources, R501 through R504, and matched summing resistors, R500. The first bit of the second decade also has a passive current source but the remaining bits have active, constant current sources formed by an operational amplifier and a transistor with feedback from the emitter to the inverting input of the operational amplifier. Each active current source is adjustable over a small range and the output currents of the first and second decades are adjustable with R510 and R548.

The three outputs are summed at tp501, the input to an operational amplifier. The summing resistors R549 and R510 set the relative weighting of each decade. the operational amplifier has two signal paths. One signal path covers frequencies from D.C. to approximately 100KHz and the other signal path processes frequency above 100KHz. The input circuitry for the low frequency path is a differential pair consisting of Q625, a matched pair of FET's. Resistive

3.8 DIGITAL TO ANALOG CONVERTOR (Figure 6.8) Cont'd

divider made up of R630, R631 and R632 is used to compensate for the differences in the gate source drops of these input resistors. The output of this differential pair and their drain load resistors R626 and R627 are applied to the differential pair Q635 and Q640. Single ended output appearing at the collector of Q640 of this differential pair is applied to a differential mixer made up of Q645 and Q650. This differential mixer mixes the low frequency signal path and the high frequency signal path. The input circuitry for the high frequency signal path flows through FET Q670 through capacitor C670 to the other input of the differential mixer Q650. The collector signal Q645 is fed to inverter transistor Q655 so that a complimentary signal of the same phase is available as the output of collector of Q650 for processing in the complimentary emitter follower buffer consisting of Q660 and Q665. Diodes D650 and D655 along with resistor R656 provide the quiescent bias voltage necessary for operation of the complimentary buffer Q660 and Q665. Diodes D651 and D656 provide short circuit protection in the event that the output of this amplifier is accidentally short circuited. The feedback around the amplifier is from R662 and C662. The relatively large value of C662 acts to integrate out noise that is associated with switching transients from the D/A converter. R623 and R622 at the summing input provide a D.C. input which shifts the triangle to be symmetrical about ground. The output of the amplifier is either a triangle or ramp, depending on the FUNCTION SWITCH setting. It is sent to function switch to be channeled through the sine shaper in the sine positions and also sent to the Triangle Gain Adjust, R694, and on to the FUNCTION switch to be sent to the output amplifier in the triangle and ramp functions.

3.9 WAVEFORM SHADING AND OUTPUT CIRCUITRY (Figure 6.9)

The sine shaper is a series of diode bridges which are arranged so that they provide break points along the triangular waveform creating a sinusodial function of very low distortion with an output of the proper amplitude necessary for conditioning in the amplifier circuitry. As the input voltage is raised to any one of these diode bridges, the output current from that same bridge begins to raise until it reaches the maximum value of current supplied by the resistor-potentiometer combination and then it becomes a constant current source. Each bridge is turned off at a successively higher level. Then break points are chosen so that the triangle input is converted to a sine wave.

The square from the sync out buffer is used to switch the diode switch, D690 and D691, with adjustable current sources to produce the square wave to be used at the output. The function switch sends the selected waveform to the preamplifier. This amplifier operates the same as the triangle amplifier except that the input differential pair are matched bipolar transistors instead of FET's. At the input there are D.C. offset adjusts R697 and R698 for the sine and triangle which are switched in or out by the function switch. The fixed D.C. offsets are also implemented here by R765 and R766. The fixed D.C. offset switches also cut the grain of the amplifier in half by switching a resistor, R753, into the feedback loop. The output of the preamplifier tries dirctly into the power amplifier which is of the same type as the preamplifier, except there is another emitter follower stage to provide a lower output impedance. The amplitude and VAR D.C. Offset controls, R760 and R763, are at the input and there is a

3.9 WAVEFORM SHADING AND OUTPUT CIRCUITRY (Figure 6.9) Cont'd

potentiometer in the feedback to adjust the output voltage. The output passes through a relay which is tied to the logic power supplies for protection. If the crowbar should trip the relay prevents the output from jumping to +15V. The output passes then through the attenuator circuit. The attenuator is a series of T pad attenuators that are switched in or out by the pushbuttons. The attenuators are arranged such that the 50Ω transmission line impedance is maintained at the output. Finally there is a filter at the output to insure that the clock noise is kept at a low level.

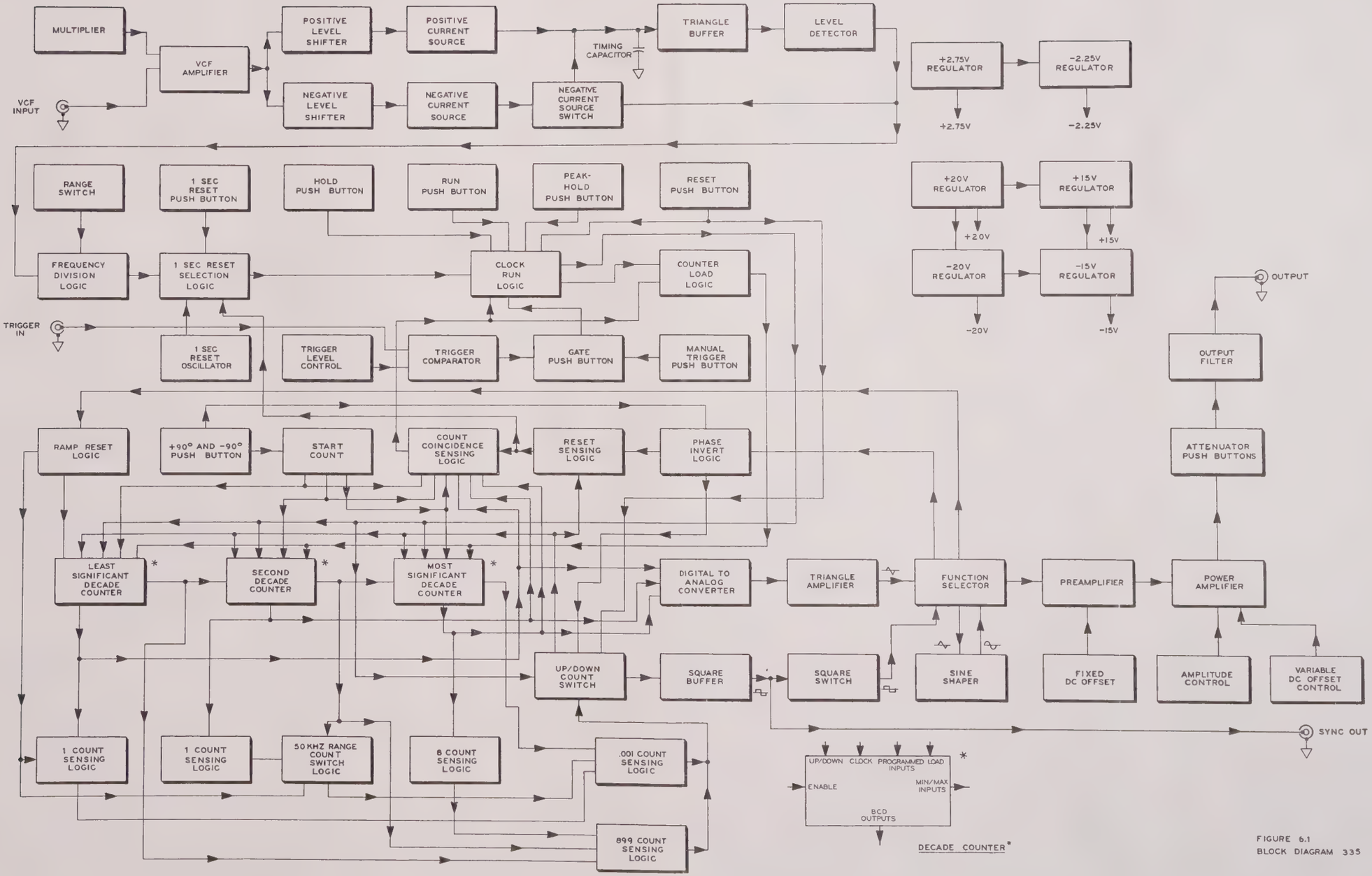


FIGURE 6.1
BLOCK DIAGRAM 335

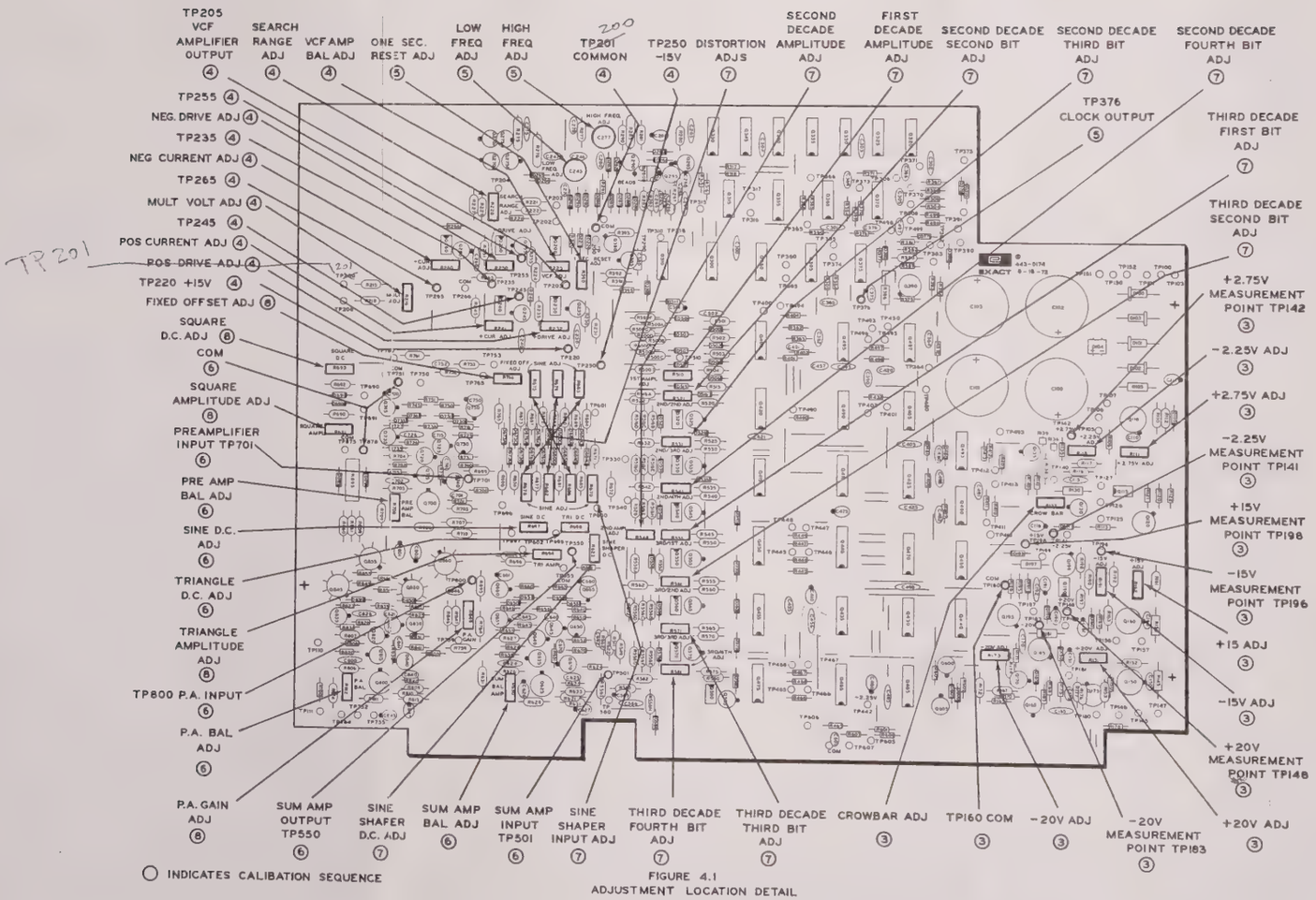

TP205 VCF AMPLIFIER OUTPUT ④
SEARCH RANGE ADJ ④
VCF AMP BAL ADJ ④
ONE SEC. RESET ADJ ⑤
LOW FREQ ADJ ⑤
HIGH FREQ ADJ ⑤
TP201 COMMON ④
TP250 -15V ④
DISTORTION ADJS ⑦
SECOND DECADE AMPLITUDE ADJ ⑦
FIRST DECADE AMPLITUDE ADJ ⑦
SECOND DECADE SECOND BIT ADJ ⑦
SECOND DECADE THIRD BIT ADJ ⑦
SECOND DECADE FOURTH BIT ADJ ⑦
TP376 CLOCK OUTPUT ⑤
THIRD DECADE FIRST BIT ADJ ⑦
THIRD DECADE SECOND BIT ADJ ⑦
+2.75V MEASUREMENT POINT TP142 ③
-2.25V ADJ ③
+2.75V ADJ ③
-2.25V MEASUREMENT POINT TP141 ③
+15V MEASUREMENT POINT TP198 ③
-15V MEASUREMENT POINT TP196 ③
+15 ADJ ③
-15V ADJ ③
+20V MEASUREMENT POINT TP148 ③
+20V ADJ ③
-20V MEASUREMENT POINT TP183 ③
-20V ADJ ③
TP160 COM ③
CROWBAR ADJ ③
THIRD DECADE THIRD BIT ADJ ⑦
THIRD DECADE FOURTH BIT ADJ ⑦
SINE SHAPER INPUT ADJ ⑦
SUM AMP INPUT TP501 ⑥
SUM AMP BAL ADJ ⑥
SINE SHAPER D.C. ADJ ⑦
SUM AMP OUTPUT TP550 ⑥
P.A. GAIN ADJ ⑧
P.A. BAL ADJ ⑥
TP800 P.A. INPUT ⑥
TRIANGLE AMPLITUDE ADJ ⑧
TRIANGLE D.C. ADJ ⑥
SINE D.C. ADJ ⑥
PRE AMP BAL ADJ ⑥
PREAMPLIFIER INPUT TP701 ⑥
SQUARE AMPLITUDE ADJ ⑧
COM ⑥
SQUARE D.C. ADJ ⑧
FIXED OFFSET ADJ ⑧
TP220 +15V ④
POS CURRENT ADJ ④
POS DRIVE ADJ ④
MULT VOLT ADJ ④
NEG CURRENT ADJ ④
NEG. DRIVE ADJ ④
TP235 ④
TP255 ④
TP245 ④
TP265 ④
TP201
○ INDICATES CALIBATION SEQUENCE

FIGURE 4.1
ADJUSTMENT LOCATION DETAIL

SECTION 4

CALIBRATION PROCEDURE

4.1 CALIBRATION PROCEDURE (figure 4.1)

1. EQUIPMENT REQUIRED

This unit must be on for one hour with covers in place and the output terminated into 50Ω before calibration.

The following equipment or suitable equivalents of known accuracy are required for complete calibration.

Oscilloscope
Tektronix 544 with W plug-in
Counter-Timer 50KHz-.01Hz
Fairchild 8200
Digital Voltmeter .01% accuracy with 1000 megohm input impedance, floating inputs
Fairchild 7000
Harmonic Distortion Analyzer .1% residual distortion
Hewlett Packard 333

2. INITIAL CONTROL SETTINGS

POWER SWITCH	ON
RANGE	5kHz
MULTIPLIER	1.00
FUNCTION	SQUARE WAVE
ATTENUATOR	DISENGAGED
OFFSET	DISENGAGED
RUN	ENGAGED
GATE	DISENGAGED
MAN	DISENGAGED
START	DISENGAGED
HOLD	DISENGAGED
RESET	DISENGAGED
PEAK HOLD	DISENGAGED
1 SEC RESET	DISENGAGED

3. USING DVM (with tp160 as com)

A. Probe to +20V measurement point (tp 148) and adjust the +20V Adjust for +20 ± .01V.

B. Probe to -20V measurement point (tp 183) and adjust the -20V Adjust for -20 ± .01V.

C. Probe to +15V measurement point (tp 198) and adjust the +15 Adjust for +15V ± .01V.

3. USING DVM (with tp 160 as com) Cont'd

D. Probe to -15V measurement point (tp 196) and adjust the -15V Adjust for -15V ± .01V.

E. Float the DVM. High Probe to +2.75V measurement point (tp 142), low probe to -2.25V measurement point (tp 141). Turn the Crowbar Adjust fully counterclockwise. Adjust the +2.75V and -2.25V Adjusts for a reading of 5.50V ± 0.05V.(Note: Do not allow the voltage to greatly exceed 5.50V to avoid damage to the ICs.) Adjust the Crowbar Adjust until the voltage jumps to 0.7V. Turn back the +2.75V and -2.25V Adjusts and turn the power off and then on again to deactivate the Crowbar. Adjust the voltage towards 5.50V again and check that the Crowbar trips at 5.50V ± .05V. Readjust if necessary.

F. Probe to +2.75V measurement point (tp 142) (with tp 160 as com) and adjust the +2.75V Adjust for +2.75 ± .01V.

G. Probe to -2.25V measurement point (tp 141) and adjust the -2.25V Adjust for -2.25V ± .01V.

4. USING DVM (with tp 201 as com)

A. Set Multiplier to .55. Probe to Multiplier Voltage measurement point (tp 201) and adjust the Multiplier Voltage Adjust for 5.50V± .01V.

B. Set MULTIPLIER to .10. Adjust VCF Amplifier Balance for minimum change in frequency when VCF input is grounded.

C. Probe to VCF amplifier output (Tp205) and adjust SEARCH RANGE ADJUST for 5mv± .1mv.

D. Float DVM. High probe to Positive Current Drive measurement point (tp 235), low probe to +15V (tp 220) and adjust Positive Current Drive Balance Adjust for +0.005V± .1mv.

E. Float DVM. High probe to Positive Current Source measurement point (tp245), low probe to +15V (tp220) and adjust Positive Current Source Balance Adjust for +0.005V± .1mv.

F. Float DVM. High probe to Negative Current Drive measurement point (tp 255), low probe to +15V (tp 250) and adjust Negative Current Drive Balance for +0.005V± .1mv.

4. USING DVM (with tp 201 as com) Cont'd

G. Float DVM. High probe to Negative Current Source measurement point (tp 265) low probe to -15V (tp 250) and adjust Negative Current Source Balance to +.005V ± .1mv.

5. USING TIMER-COUNTER

A. Set RANGE to 1KHz and MULTIPLIER TO .10. Connect counter to OUTPUT. Adjust Low Frequency Adjust for 100Hz ± 1Hz.

B. Set MULTIPLIER TO 1.00. Adjust High Frequency Adjust for 1KHz ± 10Hz.

C. Set MULTIPLIER to bottom of search and adjust Search Range Adjust to 1Hz.

D. Repeat steps A and B and C several times because of interaction.

E. Check MULTIPLIER tracking.

F. Set MULTIPLIER to 1.00. Probe to clock output (tp 376). Check RANGE tracking. The clock rate should be 1800 times the RANGE setting except on the 50KHz range where it should be 180 times.

G. Engage 1 SEC RESET. Adjust frequency for 1.00 sec.

6. USING DVM

A. Connect DVM to OUTPUT. Set Sine DC Adjust and Tri DC Adjust to midrange.

B. Connect a clip lead from the Power Amplifier input to ground (tp 800 and tp 878). Adjust P.A. Balance for 0.000V± .001V.

C. Move the clip lead to the Preamplifier input and ground (Tp 701 and Tp 751). Adjus t Preamp Bal for 0.000V± .001V.

D. Move the clip lead to the summing amplifier input and output (Tp 501 and Tp 550). Adjust sum Amp Bal for 0.000V± .001V. Remove clip lead.

7. USING HARMONIC DISTORTION ANALYZER AND OSCILLOSCOPE

A. Set RANGE to 100Hz, MULTIPLIER to 1.00, and FUNCTION to sine. Connect the distortion analyser to OUTPUT and connect the scope to distortion analyzer output (distortion products). The scope trace should be as in figure 4.6.1. (Some noise is to be expected.)

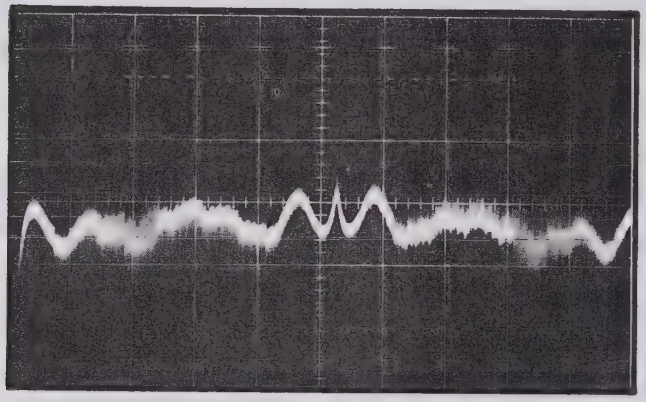


Figure 4.6.1

B. Turn Second Decade Amplitude Adjust. Obtain a scope trace as in figure 4.6.2.

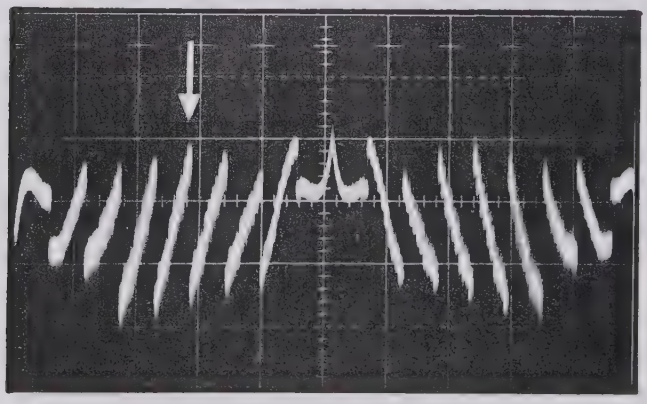


Figure 4.6.2

7. USING HARMONIC DISTORTION ANALYZER AND OSCILLOSCOPE Cont'd

Expand the portion that the arrow points to and adjust First Decade Amplitude and Second Decade Bit Adjust to obtain a trace as in figure 4.6.3.

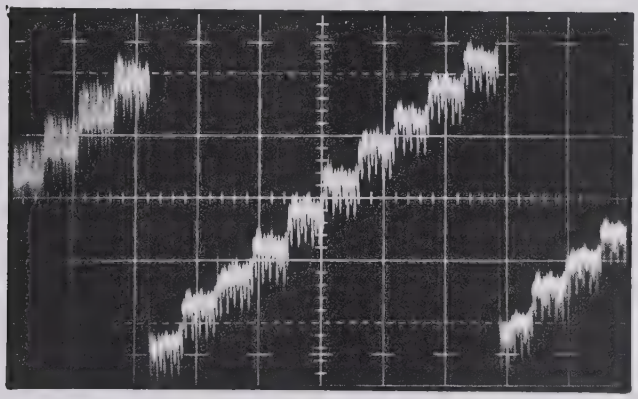


Figure 4.6.3

Now readjust the Second Decade Amplitude Adjust to produce a smooth curve.

C. Reset the scope to again see a trace as in fig. 4.6.1. Adjust the Third Decade Bit Adjusts to produce the smoothest possible line.

D. Now adjust the Sine Shaper Input, D.C. and Distortion Adjusts for minimum sine distortion. (Note: Keep in mind that the D/A converter adjusts must be set for maximum linearity and not minimum sine distortion.)

E. Repeat steps C and D several times because of interaction.

8. USING DVM

A. Connect OUTPUT terminated into 50Ω to DVM. Release Run and set FUNCTION to sine. The positive peak will read on the DVM when -90° is engaged, the negative peak will read when +90° is depressed. Adjust the Power Amplifier Gain Adjust and Sine D. C. Adjust to obtain peaks of 5.000V +.050V -000V.

B. Set FUNCTION to triangle and adjust Triangle Amplitude and Triangle D. C. Adjusts to obtain peaks of 5.000 +.050V -.000V.

C. Set FUNCTION to square and adjust Square Amplitude and Square D. C. Adjusts to obtain peaks of 5.000 + .050V -.000V.

D. Set FUNCTION to triangle. Engage POS OFFSET AND -90° START. Adjust Fixed D.C. Offset Adjust ot 0.000 ± 5mv.

E. Release -90°. Engage +90° and INV OFFSET. Adjust Fixed D. C. Offset Adjust to the best compromise between steps D and E.

SECTION 5

PARTS LIST

CODE LIST OF MANUFACTURERS

Code No	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Sprgs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00334	Humidell Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Prod. Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Eng. Labs, Inc.	Burlington, Wis.
00853	Sangamo Electric Co. Ordill Div. (Caps)	Marion, Illinois
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Prod. Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Inc.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Illinois
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp/Amer.	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg El. Corp.	Chicago, Illinois
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Company of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E., Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine and Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Electric Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q, Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co. Electronics Div.	Burbank, Calif.
04354	Precision Paper Tube Co.	Chicago, Illinois
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prod., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola/Semicon. Prod.	Phoenix, Ariz.ona
04732	Filtron Co/Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Illinois
04797	Automatic Elect. Sales Corp.	Northlake, Illinois
04796	Sequoia Wire/Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Co.	Chicago, Illinois
05006	20th Century Plastics	Los Angeles, Calif.
05277	Westinghouse/Semicon. Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Eng. Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Illinois
05728	Tiffen Optical Co.	Roslyn Heights, L.I., N.Y.
05729	Metropolitan Telecomm. Corp Metro Cap Div.	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical	Rochester, N.Y.
06402	E.T.A. Products/Amer.	Chicago, Illinois
06475	Western Devices, Inc.	Inglewood, Calif.
06540	Amatom Elect. Hardware Co.	New Rochelle, N.Y.
06555	Beede Electrical Inst.Co.	Penacook, N.H.
06751	U.S. Semcor Div. of Nuclear Corp/Amer.	Phoenix, Ariz.
06812	Torrington Mfg Co, West Div.	Van Nuys, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07115	Corning Glass Works Electronics Comp. Dept.	Bradford, Pa.
07126	Digitron Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Labs	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08189	Bliss, Delbert, Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario
08717	Sloan Company	Burbank, Calif.
08718	Cannon Elect Co., Phoenix Div	Phoenix, Ariz.
08792	CBS Elect. Semiconductor Oper., Div. C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Arahm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Illinois
09569	Mallory Battery Co/Canada Ltd.	Toronto, Ontario, Canada
09664	The Bristol Company	Waterbury, Conn.
10214	Gen. Trans. Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
05917	Exact Electronics, Inc	Hillsboro, Oreg.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Tel. of Calif., Inc	S. Pasadena, Calif.
11312	Microwave Elect. Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	Gen'l Inst/Semiconductor Div	Newark, N.J.
12117	Imperial Electronic, Inc.	Buena Park, Calif.

Code No.	Manufacturer	Address
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N.J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Elect. Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G,M,B,H,)	Hannover, Germany
13835	Midland Mfg. Co.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components Inc.	Conshohocken, Pa.
14655	Cornell Dubilier El. Corp.	So. Plainfield, N.J.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Elect., Co., Inc.	Brooklyn, N.Y.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15909	The Doven Co.	Livingston, N.J.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16352	Computer Diode Corp.	Lodi, N.J.
16688	De Jur-Amsco Corp.	Long Island City, N.Y.
16758	Delco Radio, Division of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics, Inc.	Conoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
18486	Radio Industries	Des Plaines, Illinois
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18873	E.I. Dupont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries Div. McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fentsel Metallurgical Corp.	No. Chicago, Illinois
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E. Lamp Div.	Nela Park, Cleveland, Ohio
24655	General Radio Co.	W. Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co/America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	GE Receiving Tube Dept.	Owensboro, Ky.
33473	Lectrohm, Inc.	Chicago, Ill.
36196	Stanmark Corp.	Hawkesbury, Ontario, Cd.
37942	P.R. Mallory and Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod.	Akron, Ohio
40920	Miniature Precision Bearings	Keene, N.H.
42190	Muter Co.	Chicago, Illinois
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Illinois
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer/Inst.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
63743	Ward Leonard Electric	Mt. Vernon, N.Y.
64264	Shallcross Mfg. Co.	Selma, N.C.
65026	Simpson Electric Co.	Chicago, Illinois
65933	Sonotone Corp.	Elmsford, N.Y.
65938	Sorenson and Co., Inc.	S. Norwalk, Conn.
66137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
66289	Sprague Electric Co.	N. Adams, Mass.
66346	Telex, Inc.	St. Paul, Minn.
67942	Thomas and Betts Co.	Elizabeth, N.J.
68994	Tripplett Electrical Inc.	Bluffton, Ohio
69063	Union Switch and Signal, Div. Westinghouse Air Brake Co.	Swissvale, Pa.
72119	Universal Electric Co.	Osasso, Mich.
72447	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
72619	Western Electric Co., Inc.	New York, N.Y.
72699	West Inst./Div. Daystrom	Newark, N.J.
72765	Wirtek Manufacturing Co.	Chicago, Illinois
72982	Wallensak Optical Co.	Rochester, N.Y.
73076	Allen Manufacturing Co.	Hartford, Conn.
73080	Allied Control Co., Inc.	New York, N.Y.
73138	Allmetal Screw Prod. Co, Inc.	Garden City, N.Y.
73293	Atlantic India Rubber Works	Chicago, Illinois
73445	Amperex Electronic Co., Div. No. American Phillips Co., Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	S. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Illinois
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73846	Goshen Stamping and Tool	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signetics, Inc.	Neptune, N.J.,
74455	J. H. Winns and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Illinois
74868	R.F. Prod. Div., of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Div. of Cinch Mfg. Corp.	Chicago, Illinois
75378	James Knights Co.	Sandwich, Illinois
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lanz Electric Mfg. Co.	Chicago, Illinois
75915	Littlefuse, Inc.	Des Plaines, Illinois
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Crystal Lake, Illinois
77068	Bendix Pacific Div. of Bendix Corp.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostron Instrument and Electronic Co.	S. Pasadena, Calif.
77250	Phaoli Manufacturing Co.	Chicago, Illinois
77252	Philadelphia Steel and Wire Corporation	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine/Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof, Div. of Illinois Tool Works	Elgin, Illinois
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn, Inc.	Pitman, N.J.
78452	Thompson-Bremer and Co.	Chicago, Illinois
78471	Tilley Manufacturing Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transistor Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mas.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Illinois
79727	Continental-Wirt Elect. Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco, Div. of Sessions Clock Company	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Assoc. Any brand tube meeting EIA standards.	Washington D.C.
80207	Unimax Switch, Div. of W L Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Illinois
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro, Div of Robertshaw Fulton Controls Co.	Columbus, Ohio Columbus, Ohio
80486	All Star Products, Inc.	Defiance, Ohio
80509	Avary Adhesive Label Corp.	Monrovia, Calif.
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Graybill Co.	LaGrange, Illinois
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co,	Norwalk, Conn.
81349	Military Specifications	- - - - - - - - - -
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div, Industrial Tube Oper.	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Illinois
82142	Jeffers Electronics, Div. of Speer Carbon Co.	DuBois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Electronic Tube Div.	Emporium, Pa.
82376	Astron Company	E. Newark, N.J.
82389	Switchcraft, Inc.	Orange, Illinois
82647	Metals and Controls, Inc., Div. Texas Instruments, Spencer Products	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wisc.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, California
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Springfield, N.J.
83298	Bendix Corp/Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Illinois
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Illinois
83501	Gavitt Wire and Cable Co., Div. Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div	Plainfield, N.J.

Code No.	Manufacturer	Address
83740	Eveready Battery	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics, Inc.	New York, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Co.	Boonton, N.J.
85474	R.M. Bracamonte and Co.	San Francisco, Calif.
85660	Kailed Kards, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Illinois
86197	Clifton Precision Products	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corp. (Lansing Div.)	Lansing, Pa.
87473	Western Fibroid Glass Products Co.	San Francisco
87664	Van Waters and Rogers, Inc.	Seattle, Wash.
87930	Tower Mfg. Co.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Illinois
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89462	Walden Kohinaar, Inc.	Cambridge, Mass.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baker Co.	Chicago, Illinois
89665	United Transformer Co.	Chicago, Illinois
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial and Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Illinois
91506	August Brothers', Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corp.	Philadelphia
91737	Gremar Mfg Co., Inc.	Wakefield. Mass.
91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Illinois
91961	Nahm-Bras. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.
93332	Sylvania Electric Prod, Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93788	Howard J. Smith, Inc.	Port Monmouth, N.J.
93929	G.V. Controls	Livingston, N.J.
93983	Insulina-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Mfg. Co., Industrial Comp. Div, Rec. Tube Div.	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div, Calif. St. Plt	Newton, Mass.
94148	Scientific Radio Products	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtis-Wright Corp. Electronics Div.	E. Paterson, N.J.
94222	Southco, Div. 5, Chester Corp.	Lester, Pa.
94310	Tru Ohm Prod., Div. Model Engineering and Mfg. Co.	Chicago, Illinois
94330	Wire Cloth Products, Inc.	Chicago, Illinois
94682	Worcester Pressed Alum. Corp.	Worcester, Mass.
95023	Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Illinois
95712	Doge Electric Co., Inc.	Franklin, Ind.
95987	Weckesser Co.	Chicago, Illinois
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner, Div. Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Illinois
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J
97539	Automatic and Precision Mfg.	Yonkers, N.Y.
97966	CBS Electronics Div. C.B.S., Inc.	Danvers, Mass.
97979	Rean Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	S. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98731	General Mills	Minneapolis, Minn.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Div, Controls Co. of America	El Segundo, Calif
99800	Delevan Electronics Corp.	E. Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind
99934	Renbrandt, Inc.	Boston, Mass
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Illinois
99957	Technology Instrument Corp. of California	Newbury Park, Calif.

PART	DESCRIPTION	EXACT NO	MFG
B0100	PILOT LIGHT	1362045	71744
C0100	CAPACITOR, 6500MFD 15V	2900049	853
C0101	CAPACITOR, 6500MFD 15V	2900049	853
C0102	CAPACITOR, 2500MFD 35V	2900034	853
C0103	CAPACITOR, 2500MFD 35V	2900034	853
C0104	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0110	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0111	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0115	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0116	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0150	CAPACITOR, 47PF MICA	2810539	853
C0151	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0160	CAPACITOR, 47PF MICA	2810539	853
C0161	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0165	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0170	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0175	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0190	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0191	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0192	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0232	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0242	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0245	CAPACITOR, 5,5-18PF TRIM	2810011	72982
C0246	CAPACITOR, 100PF MICA	2810537	853
C0247	CAPACITOR, 10PF MICA	2810529	853
C0260	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0270	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0275	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0277	CAPACITOR, 5,5-18PF TRIM	2810011	72982
C0278	CAPACITOR, 22PF MICA	2810530	853
C0280	CAPACITOR, 5PF MICA	2810501	853
C0285	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0286	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0295	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0296	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0297	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0298	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0300	TO		
C0304	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0365	CAPACITOR, 68PF MICA	2810523	853
C0366	CAPACITOR, 390PF MICA	2810556	853
C0367	CAPACITOR, 47PF MICA	2810539	853
C0368	CAPACITOR, 68PF MICA	2810523	853
C0369	CAPACITOR, 68PF MICA	2810523	853
C0370	CAPACITOR, 68PF MICA	2810523	853
C0375	CAPACITOR, 22PF MICA	2810530	853
C0382	CAPACITOR, 0,05 MFD 50 VOLT	2900052	10597
C0400	CAPACITOR, 68PF MICA	2810523	853
C0401	CAPACITOR, 22PF MICA	2810530	853
C0405	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0410	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0422	CAPACITOR, 100PF MICA	2810537	853
C0421	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0425	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0455	CAPACITOR, 100PF MICA	2810537	853
C0456	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0457	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0475	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0480	CAPACITOR, 100PF MICA	2810537	853
C0481	CAPACITOR, 100PF MICA	2810537	853
C0482	CAPACITOR, 100PF MICA	2810537	853
C0485	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0486	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0497	CAPACITOR, 68PF MICA	2810523	853
C0498	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0501	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0502	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0585	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0586	CAPACITOR, 0,05 UF DISCAP	2830010	91418
C0607	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0624	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0625	CAPACITOR, 100PF MICA	2810537	853
C0626	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0627	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0640	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0645	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0660	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0661	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0662	CAPACITOR, 22PF MICA	2810555	853
C0670	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0700	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0701	CAPACITOR, 10PF MICA	2810537	853
C0702	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0703	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0715	CAPACITOR, 1000 PF DISCAP	2830000	91418
C0726	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0740	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0750	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0752	CAPACITOR, 12PF MICA	2810534	853
C0800	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0801	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0812	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0821	CAPACITOR, 1500 PF DISCAP	2830000	91418
C0826	CAPACITOR, 0,01 UF DISCAP	2830005	91418
C0840	CAPACITOR, 10PF MICA	2810537	853
C0841	CAPACITOR, 5000 PF DISCAP	2830011	91418
C0845	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0846	CAPACITOR, 22PF MICA	2810555	853
C0847	CAPACITOR, 6,8 MFD 35 VOLT	2900043	100002
C0870	CAPACITOR, 1000PF MICA	2810560	853
C0871	CAPACITOR, 1000PF MICA	2810560	853
D0100	TO		
D0103	DIODE, 1N4719	1524719	4713
D0104	RECTIFIER BRIDGE, PDA920A-3	1529920	4713
D0110	DIODE, 1N4001	1524001	1295
D0111	DIODE, 1N4001	1524001	1295
D0150	DIODE, 1N4001	1524001	1295

PART	DESCRIPTION	EXACT NO	MFG
D0160	DIODE, 1N4001	1524001	1295
D0185	DIODE, 1N914	1520914	7910
D0190	DIODE, 1N4001	1524001	1295
D0191	DIODE, 1N4001	1524001	1295
D0193	DIODE, 1N757	1528757	1295
D0220	DIODE, 1N914	1520914	7910
D0221	DIODE, 1N914	1520914	7910
D0265	DIODE, HOT CARRIER	1522835	10597
D0266	DIODE, HOT CARRIER	1522835	10597
D0280	DIODE, HOT CARRIER	1522835	10597
D0281	DIODE, HOT CARRIER	1522835	10597
D0282	DIODE, HOT CARRIER	1522835	10597
D0283	DIODE, HOT CARRIER	1522835	10597
D0285	DIODE, HOT CARRIER	1522835	10597
D0286	DIODE, HOT CARRIER	1522835	10597
D0287	TO		
D0292	DIODE, 1N914	1520914	7910
D0295	DIODE, 1N914	1520914	7910
D0310	DIODE, 1N914	1520914	7910
D0311	DIODE, 1N914	1520914	7910
D0375	DIODE, 1N914	1520914	7910
D0376	DIODE, 1N914	1520914	7910
D0377	DIODE, HOT CARRIER	1522835	10597
D0380	DIODE, 1N751	1528751	4713
D0480	DIODE, 1N914	1520914	7910
D0481	DIODE, 1N914	1520914	7910
D0500	TO		
D0507	DIODE, 1N914	1520914	7910
D0515	DIODE, 1N914	1520914	7910
D0516	DIODE, 1N914	1520914	7910
D0525	DIODE, 1N914	1520914	7910
D0526	DIODE, 1N914	1520914	7910
D0535	DIODE, 1N914	1520914	7910
D0536	DIODE, 1N914	1520914	7910
D0545	DIODE, 1N914	1520914	7910
D0546	DIODE, 1N914	1520914	7910
D0555	DIODE, 1N914	1520914	7910
D0556	DIODE, 1N914	1520914	7910
D0565	DIODE, 1N914	1520914	7910
D0566	DIODE, 1N914	1520914	7910
D0575	DIODE, 1N914	1520914	7910
D0576	DIODE, 1N914	1520914	7910
D0585	DIODE, 1N914	1520914	7910
D0586	DIODE, 1N914	1520914	7910
D0620	DIODE, 1N914	1520914	7910
D0625	DIODE, 1N914	1520914	7910
D0650	DIODE, 1N914	1520914	7910
D0651	DIODE, 1N914	1520914	7910
D0655	DIODE, 1N914	1520914	7910
D0656	DIODE, 1N914	1520914	7910
D0673	DIODES, MATCHED SET 1N914	1530914	10597
D0676	DIODES, MATCHED SET 1N914	1530914	10597
D0680	DIODES, MATCHED SET 1N914	1530914	10597
D0684	DIODES, MATCHED SET 1N914	1530914	10597
D0690	DIODE, 1N914	1520914	7910
D0691	DIODE, 1N914	1520914	7910
D0730	DIODE, 1N914	1520914	7910
D0731	DIODE, 1N914	1520914	7910
D0735	DIODE, 1N914	1520914	7910
D0736	DIODE, 1N914	1520914	7910
D0759	RESISTOR, 2320 OHM 1/4W 1% METAL FILM	3132321	7115
D0830	DIODE, 1N914	1520914	7910
D0835	DIODE, 1N914	1520914	7910
D0895	DIODE, 1N914	1520914	7910
D0896	DIODE, 1N914	1520914	7910
K0895	RELAY, SPST REED 5 VOLT	2600328	10597
L0280	BEAD, FERRITE G343	1140234	1121
L0281	BEAD, FERRITE G343	1140234	1121
L2872	CHOKE, 4.7 MICRO-HENRY	1140233	76493
Q0105	TRANSISTOR, 2N4898	1564898	4713
Q0110	INTEGRATED CIRCUIT, UA723	1580012	7263
Q0115	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0120	TRANSISTOR, 2N2925	1562925	1295
Q0125	TRANSISTOR, 2N4898	1564898	4713
Q0130	TRANSISTOR, E2484	1562484	7263
Q0135	TRANSISTOR, 2N4250	1564250	7263
Q0140	CONTROLLED RECTIFIER, 2N4167	1564167	4713
Q0145	TRANSISTOR, 2N4910	1564910	4713
Q0150	INTEGRATED CIRCUIT, UA723	1580012	7263
Q0155	TRANSISTOR, 2N4910	1564910	4713
Q0164	INTEGRATED CIRCUIT, UA723	1580012	7263
Q0165	TRANSISTOR, 2N4121	1564121	7263
Q0170	TRANSISTOR, 2N4121	1564121	7263
Q0175	TRANSISTOR, 2N2219	1562219	1295
Q0180	TRANSISTOR, 2N4898	1564898	4713
Q0185	TRANSISTOR, 2N2219	1562219	1295
Q0190	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0195	TRANSISTOR, 2N2905	1562905	1295
Q0197	TRANSISTOR, 2N4898	1564898	4713
Q0199	TRANSISTOR, 2N2219	1562219	1295
Q0200	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0230	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0235	TRANSISTOR, 2N5485	1565485	4713
Q0240	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0245	TRANSISTOR, 2N4250	1564250	7263
Q0250	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0255	TRANSISTOR, 2N4250	1564250	7263
Q0260	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0265	TRANSISTOR, E2484	1562484	7263
Q0270	TRANSISTORS, MATCHED 2N5485	1575485	10597
Q0275	TRANSISTORS, MATCHED PAIR MPS3646	1573646	10597
Q0280	TRANSISTORS, MATCHED TIS87	1573087	10597
Q0285	TRANSISTOR, 2N4258	1564258	7263
Q0290	TRANSISTOR, 2N4258	1564258	7263
Q0295	TRANSISTOR, MPS3563	1563563	4713
Q0300	INTEGRATED CIRCUIT, SN7495A	1587824	1295
Q0305	INTEGRATED CIRCUIT, SN74S20	1583944	1295
Q0310	INTEGRATED CIRCUIT, SN74821	1582821	1295

PART	DESCRIPTION	EXACT NO	MFG
Q0315	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0320	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0325	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0330	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0335	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0340	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0345	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0350	INTEGRATED CIRCUIT, SN7490N	1580024	1295
Q0355	INTEGRATED CIRCUIT, SN74151N	1580041	1295
Q0360	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0365	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0370	INTEGRATED CIRCUIT, SN7420N	1580033	1295
Q0375	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0380	TRANSISTOR, 2N2646	1562646	3508
Q0385	TRANSISTOR, MPS3646	1563646	4713
Q0390	INTEGRATED CIRCUIT, UA710C	1580020	7263
Q0400	INTEGRATED CIRCUIT, SN74S10N	1580038	1295
Q0405	INTEGRATED CIRCUIT, SN7402N	1580021	1295
Q0410	INTEGRATED CIRCUIT, SN74190N	1580034	1295
Q0415	INTEGRATED CIRCUIT, SN7486N	1580035	1295
Q0420	INTEGRATED CIRCUIT, SN7423N	1580036	1295
Q0425	INTEGRATED CIRCUIT, SN7408N	1580037	1295
Q0430	INTEGRATED CIRCUIT, SN74S00N	1580044	1295
Q0435	INTEGRATED CIRCUIT, SN7410N	1580032	1295
Q0440	INTEGRATED CIRCUIT, SN7410N	1580032	1295
Q0445	INTEGRATED CIRCUIT, SN74190N	1580034	1295
Q0450	INTEGRATED CIRCUIT, SN7486N	1580035	1295
Q0455	INTEGRATED CIRCUIT, SN7423N	1580036	1295
Q0460	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0465	INTEGRATED CIRCUIT, SN74190N	1580034	1295
Q0470	INTEGRATED CIRCUIT, SN7423N	1580036	1295
Q0475	INTEGRATED CIRCUIT, SN7486N	1580035	1295
Q0480	INTEGRATED CIRCUIT, SN7410N	1580032	1295
Q0485	INTEGRATED CIRCUIT, SN74S112N	1580039	1295
Q0490	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0493	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0495	INTEGRATED CIRCUIT, SN7420N	1580033	1295
Q0497	INTEGRATED CIRCUIT, SN7400N	1580011	1295
Q0520	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0525	TRANSISTOR, 2N4250	1564250	7263
Q0530	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0535	TRANSISTOR, 2N4250	1564250	7263
Q0540	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0545	TRANSISTOR, 2N4250	1564250	7263
Q0550	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0555	TRANSISTOR, 2N4250	1564250	7263
Q0560	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0565	TRANSISTOR, 2N4250	1564250	7263
Q0570	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0575	TRANSISTOR, 2N4250	1564250	7263
Q0580	OPERATIONAL AMPLIFIER, UA741	1580010	7263
Q0585	TRANSISTOR, 2N4250	1564250	7263
Q0600	TRANSISTOR, TIS87	1560087	1295
Q0605	TRANSISTOR, 2N4121	1564121	7263
Q0625	TRANSISTOR, 2N5454	1565454	61637
Q0635	TRANSISTOR, 2N4250	1564250	7263
Q0640	TRANSISTOR, 2N4250	1564250	7263
Q0645	TRANSISTOR, MPS6543	1566543	4713
Q0650	TRANSISTOR, MPS3646	1563646	4713
Q0655	TRANSISTOR, 2N4121	1564121	7263
Q0660	TRANSISTOR, TIS87	1560087	1295
Q0665	TRANSISTOR, 2N4121	1564121	7263
Q0670	TRANSISTOR, 2N5485	1565485	4713
Q0700	TRANSISTOR, 2N4045	1564045	7263
Q0715	TRANSISTOR, 2N4250	1564250	7263
Q0720	TRANSISTOR, 2N4250	1564250	7263
Q0725	TRANSISTOR, MPS6543	1566543	4713
Q0730	TRANSISTOR, TIS87	1560087	1295
Q0735	TRANSISTOR, 2N4121	1564121	7263
Q0740	TRANSISTOR, 2N5485	1565485	4713
Q0745	TRANSISTOR, TIS87	1560087	1295
Q0750	TRANSISTOR, 2N4121	1564121	7263
Q0802	TRANSISTOR, 2N4045	1564045	7263
Q0815	TRANSISTOR, 2N4250	1564250	7263
Q0822	TRANSISTOR, 2N4250	1564250	7263
Q0825	TRANSISTOR, MPS6543	1566543	4713
Q0830	TRANSISTOR, TIS87	1560087	1295
Q0835	TRANSISTOR, 2N4121	1564121	7263
Q0842	TRANSISTOR, 2N5485	1565485	4713
Q0845	TRANSISTOR, 2N2219	1562219	1295
Q0850	TRANSISTOR, 2N2905	1562905	1295
Q0855	TRANSISTOR, 2N2219	1562219	1295
Q0860	TRANSISTOR, 2N2905	1562905	1295
R0100	RESISTOR, 68K OHM 1/4W 5% CARBON	3070683	1121
R0105	RESISTOR, 0.3 OHM WIREWOUND	3080003	75042
R0106	RESISTOR, 56 OHM 1/4W 5% CARBON	3070560	1121
R0110	RESISTOR, 14300 OHM 1/4W 1% METAL FILM	3131402	7115
R0111	POTENTIOMETER, 2K OHM PC TRIM	3110130	74468
R0112	RESISTOR, 9310 OHM 1/4W 1% METAL FILM	3139311	7115
R0115	RESISTOR, 220Ω OHM 1/4W 5% CARBON	3070222	1121
R0116	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0117	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R0118	POTENTIOMETER, 2K OHM PC TRIM	3110130	74468
R0120	RESISTOR, 680 OHM 1/4W 5% CARBON	3070681	1121
R0121	RESISTOR, 100Ω OHM 1/4W 5% CARBON	3070102	1121
R0122	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0130	RESISTOR, 0.3 OHM WIREWOUND	3080003	75042
R0135	RESISTOR, 300 OHM 1/4W 5% CARBON	3070301	1121
R0136	RESISTOR, 5.6 OHM THERMISTOR	3170056	1295
R0137	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0138	RESISTOR, 1910 OHM 1/4W 1% METAL FILM	3131911	7115
R0139	RESISTOR, 5200 OHM THERMISTOR	3175001	1295
R0140	RESISTOR, 120 OHM 1/4W 5% CARBON	3070121	1121
R0141	RESISTOR, 1600 OHM 1/4W 5% CARBON	3070162	1121
R0145	RESISTOR, 1.0 OHM 1/2W 5% CARBON	3010010	1121
R0150	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0151	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0152	RESISTOR, 562Ω OHM 1/4W 1% METAL FILM	3135621	7115
R0153	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0155	RESISTOR, 1.0 OHM 1/2W 5% CARBON	3010010	1121
R0160	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0161	RESISTOR, 3320 OHM 1/4W 1% METAL FILM	3133321	7115
R0162	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0163	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0165	RESISTOR, 5100 OHM 1/4W 5% CARBON	3070512	1121
R0166	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0167	RESISTOR, 36500 OHM 1/4W 1% METAL FILM	3133652	7115
R0170	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0171	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0172	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0173	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0174	RESISTOR, 12700 OHM 1/4W 1% METAL FILM	3131272	7115
R0175	RESISTOR, 360 OHM 1/4W 5% CARBON	3070361	1121
R0176	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0177	RESISTOR, 100 OHM 1/4W 1% METAL FILM	3131000	7115
R0178	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R0181	RESISTOR, 1.0 OHM 1/2W 5% CARBON	3010010	1121
R0185	RESISTOR, 13K OHM 1/4W 5% CARBON	3070133	1121
R0190	RESISTOR, 22100 OHM 1/4W 1% METAL FILM	3132212	7115
R0191	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0192	RESISTOR, 15000 OHM 1/4W 1% METAL FILM	3131502	7115
R0194	RESISTOR, 8060 OHM 1/4W 1% METAL FILM	3138061	7115
R0195	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0196	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0197	RESISTOR, 1.0 OHM 1/2W 5% CARBON	3010010	1121
R0198	RESISTOR, 34800 OHM 1/4W 1% METAL FILM	3133482	7115
R0201	TO		
R0212	RESISTOR, 100 OHM 1/4W 1% METAL FILM	3131000	7115
R0213	RESISTOR, SELECTED VALUE		
R0215	RESISTOR, 1820 OHM 1/4W 1% METAL FILM	3131821	7115
R0216	POTENTIOMETER, 250 OHM	3110145	71450
R0218	RESISTOR, 402 OHM 1/4W 1% METAL FILM	3134020	7115
R0220	RESISTOR, 4700 OHM 1/4W 5% CARBON	3070472	1121
R0221	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0222	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0224	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0225	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0226	RESISTOR, 1200K OHM 1/4W 5% CARBON	3070125	1121
R0227	RESISTOR, 9530 OHM 1/4W 1% METAL FILM	3139531	7115
R0228	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0229	RESISTOR, 9530 OHM 1/4W 1% METAL FILM	3139531	7115
R0230	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0231	RESISTOR, 499 OHM 1/4W 1% METAL FILM	3134990	7115
R0232	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0235	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0241	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0245	RESISTOR, 806 OHM 1/4W 1% METAL FILM	3138060	7115
R0246	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0250	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0251	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0255	RESISTOR, 1000 OHM 1/4W 1% METAL FILM	3131001	7115
R0260	POTENTIOMETER, 10K OHM TRIM	3110150	71450
R0265	RESISTOR, 475 OHM 1/4W 1% METAL FILM	3134750	7115
R0266	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0275	RESISTOR, 301 OHM 1/2W 1% METAL FILM	3103010	7115
R0276	RESISTOR, 499 OHM 1/2W 1% METAL FILM	3104990	7115
R0277	RESISTOR, 715 OHM 1/4W 1% METAL FILM	3137150	7115
R0280	RESISTOR, 4220 OHM 1/4W 1% METAL FILM	3134221	7115
R0281	RESISTOR, 4220 OHM 1/4W 1% METAL FILM	3134221	7115
R0282	RESISTOR, 402 OHM 1/4W 1% METAL FILM	3134020	7115
R0283	RESISTOR, 301 OHM 1/4W 1% METAL FILM	3133010	7115
R0285	RESISTOR, 348 OHM 1/2W 1% METAL FILM	3103480	7115
R0290	RESISTOR, 5920 OHM 1/4W 1% METAL FILM	3135901	7115
R0291	RESISTOR, 1800 OHM 1/4W 5% CARBON	3070182	1121
R0295	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0296	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R2297	RESISTOR, 2210 OHM 1/4W 1% METAL FILM	3132211	7115
R0304	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0305	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0306	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0315	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0316	TO		
R0318	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0360	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0361	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0362	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0363	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0364	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0365	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0366	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0367	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0368	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0369	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0370	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0371	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0372	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0375	RESISTOR, 619 OHM 1/4W 1% METAL FILM	3136190	7115
R0376	RESISTOR, 1500 OHM 1/4W 5% CARBON	3070501	1121
R0377	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0380	RESISTOR, 316K OHM 1/4W 1% METAL FILM	3133163	7115
R0381	RESISTOR, 27K OHM 1/4W 5% CARBON	3070273	1121
R0382	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0383	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0384	RESISTOR, 1100 OHM 1/4W 5% CARBON	3070112	1121
R0385	POTENTIOMETER, 1K OHM 2 WATT	3110113	71450
R0386	RESISTOR, 360 OHM 1/2W 5% CARBON	3010361	1121
R0387	RESISTOR, 33K OHM 1/4W 5% CARBON	3070333	1121
R0390	POTENTIOMETER, 1K OHM TRIM	3110150	71450
R0391	RESISTOR, 15810 OHM 1/4W 1% METAL FILM	3131582	7115
R0392	RESISTOR, 316 OHM 1/4W 1% METAL FILM	3133160	7115
R0393	RESISTOR, 11.0 OHM 1/4W 1% METAL FILM	3130100	7115
R0395	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0401	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0402	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0403	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0404	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121

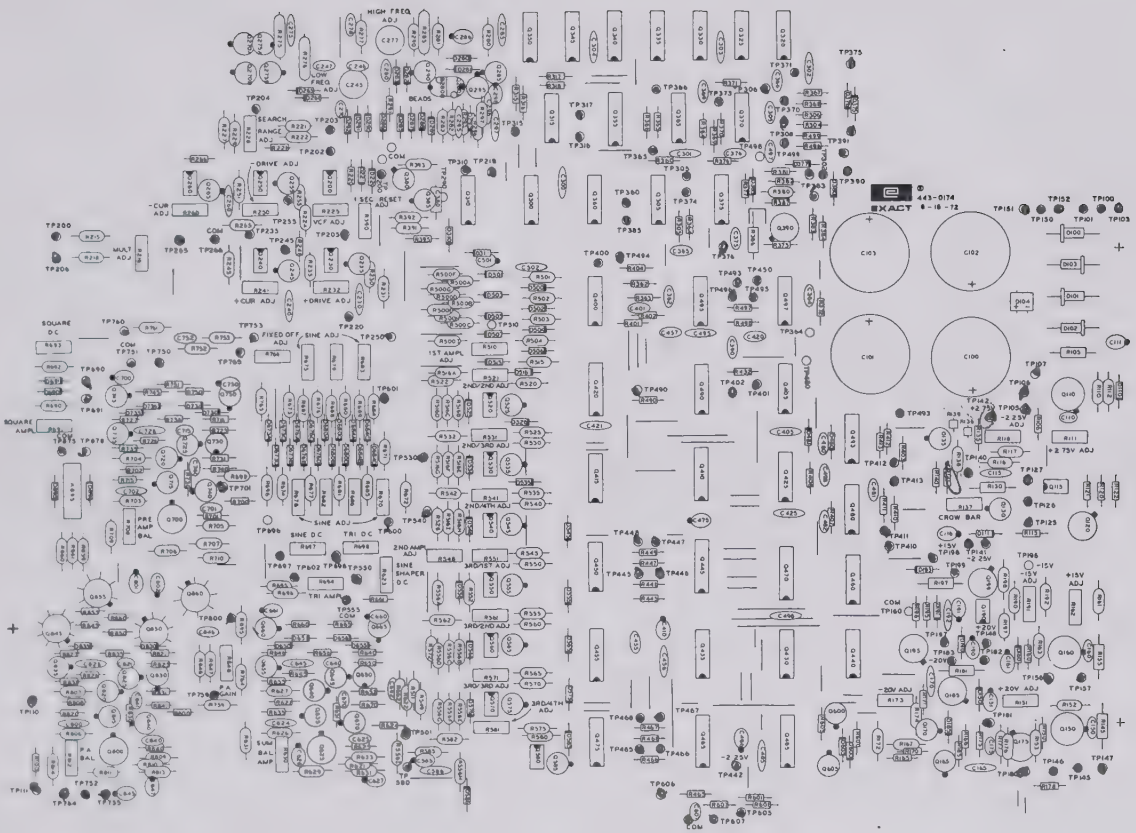
PART	DESCRIPTION	EXACT NO	MFG
R0405	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0406	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0407	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0410	TO		
R0413	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0431	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0433	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0445	TO		
R0465	TO		
R0468	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0490	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0496	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0497	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0498	RESISTOR, 2200 OHM 1/4W 5% CARBON	3070222	1121
R0499	RESISTOR, 3300 OHM 1/4W 5% CARBON	3070332	1121
R0500	RESISTORS, MATCHED SET 100 OHM	3201000	10597
R0501	TO		
R0504	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0510	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0511	RESISTOR, 9310 OHM 1/4W 1% METAL FILM	3139311	7115
R0515	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0516	RESISTORS, MATCHED SET 100 OHM	3201000	10597
R0520	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0521	POTENTIOMETER, 250 OHM	3110145	71450
R0522	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0525	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0530	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0531	POTENTIOMETER, 250 OHM	3110145	71450
R0532	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0535	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0540	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0541	POTENTIOMETER, 250 OHM	3110145	71450
R0542	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0545	RESISTOR, 3010 OHM 1/4W 1% METAL FILM	3133011	7115
R0546	RESISTOR, 12.0 OHM 1/4W 1% METAL FILM	3130100	7115
R0548	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0549	RESISTOR, 909 OHM 1/4W 1% METAL FILM	3139090	7115
R0550	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0551	POTENTIOMETER, 250 OHM	3110145	71450
R0552	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0555	RESISTOR, 2940 OHM 1/4W 1% METAL FILM	3132941	7115
R0556	RESISTORS, MATCHED SET 100 OHM	3201000	10597
R0560	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0561	POTENTIOMETER, 250 OHM	3110145	71450
R0562	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0565	RESISTOR, 2940 OHM 1/4W 1% METAL FILM	3132941	7115
R0570	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0571	POTENTIOMETER, 250 OHM	3110145	71450
R0572	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0575	RESISTOR, 2940 OHM 1/4W 1% METAL FILM	3132941	7115
R0580	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0581	POTENTIOMETER, 250 OHM	3110145	71450
R0582	RESISTOR, 5900 OHM 1/4W 1% METAL FILM	3135901	7115
R0585	RESISTOR, 2940 OHM 1/4W 1% METAL FILM	3132941	7115
R0600	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0601	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0605	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0606	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0607	RESISTOR, 100 OHM 1/4W 5% CARBON	3070101	1121
R0622	RESISTOR, 11300 OHM 1/4W 1% METAL FILM	3131132	7115
R0623	POTENTIOMETER, 1K OHM TRIM	3110147	71450
R0624	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0625	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0626	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0627	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0628	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0629	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0630	POTENTIOMETER, 5K OHM TRIM	3110149	71450
R0631	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0632	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0633	RESISTOR, 324K OHM 1/4W 1% METAL FILM	3133243	7115
R0635	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R0640	RESISTOR, 11K OHM 1/4W 5% CARBON	3070113	1121
R0645	RESISTOR, 4300 OHM 1/4W 5% CARBON	3070432	1121
R0646	RESISTOR, 360 OHM 1/4W 5% CARBON	3070361	1121
R0650	RESISTOR, 160 OHM 1/4W 5% CARBON	3070161	1121
R0651	RESISTOR, 100K OHM 1/4W 5% CARBON	3070104	1121
R0652	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0655	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0656	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0660	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0661	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0662	RESISTOR, 787 OHM 1/4W 1% METAL FILM	3137870	7115
R0665	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0670	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0671	RESISTOR, 26,1 OHM 1/4W 1% METAL FILM	3130261	7115
R0672	RESISTOR, 15.0 OHM 1/4W 1% METAL FILM	3130150	7115
R0673	RESISTOR, 14300 OHM 1/4W 1% METAL FILM	3131432	7115
R0674	RESISTOR, 14300 OHM 1/4W 1% METAL FILM	3131432	7115
R0675	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0676	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R0677	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R0678	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0679	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0680	RESISTOR, 6810 OHM 1/4W 1% METAL FILM	3136811	7115
R0681	RESISTOR, 6810 OHM 1/4W 1% METAL FILM	3136811	7115
R0682	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0683	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0684	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R0685	RESISTOR, 12100 OHM 1/4W 1% METAL FILM	3131212	7115
R0686	POTENTIOMETER, 500 OHM TRIM	3110142	71450
R0687	RESISTOR, 45.3 OHM 1/4W 1% METAL FILM	3130453	7115
R0688	RESISTOR, 93,1 OHM 1/4W 1% METAL FILM	3130931	7115
R0689	RESISTOR, 287 OHM 1/4W 1% METAL FILM	3132870	7115
R0690	RESISTOR, 1270 OHM 1/4W 1% METAL FILM	3131271	7115
R0691	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0692	RESISTOR, 2740 OHM 1/4W 1% METAL FILM	3132741	7115
R0693	POTENTIOMETER, 250 OHM	3110145	71450
R0694	POTENTIOMETER, 100 OHM TRIM	3110141	71450
R0695	RESISTOR, 127 OHM 1/4W 1% METAL FILM	3131270	7115
R0696	RESISTOR, 210K OHM 1/4W 1% METAL FILM	3132103	7115
R0697	POTENTIOMETER, 100K OHM TRIM	3110143	71450
R0698	POTENTIOMETER, 100K OHM TRIM	3110143	71450
R0699	RESISTOR, 49,9 OHM 1/4W 1% METAL FILM	3130499	7115
R0700	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0701	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0702	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0703	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0704	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0705	RESISTOR, 324K OHM 1/4W 1% METAL FILM	3133243	7115
R0706	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0707	RESISTOR, 332 OHM 1/4W 1% METAL FILM	3133320	7115
R0708	POTENTIOMETER, 5K OHM TRIM	3110149	71450
R0709	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0710	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0715	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R0716	RESISTOR, 11K OHM 1/4W 5% CARBON	3070113	1121
R0725	RESISTOR, 160 OHM 1/4W 5% CARBON	3070161	1121
R0726	RESISTOR, 4300 OHM 1/4W 5% CARBON	3070432	1121
R0727	RESISTOR, 360 OHM 1/4W 5% CARBON	3070361	1121
R0730	RESISTOR, 100K OHM 1/4W 5% CARBON	3070104	1121
R0731	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0735	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0736	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0740	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0745	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0750	RESISTOR, 22 OHM 1/4W 5% CARBON	3070220	1121
R0751	RESISTOR, 47 OHM 1/4W 5% CARBON	3070470	1121
R0752	RESISTOR, 681 OHM 1/4W 1% METAL FILM	3136810	7115
R0753	RESISTOR, 681 OHM 1/4W 1% METAL FILM	3136810	7115
R0760	POTENTIOMETER, 500 OHM 2W	3110330	44655
R0761	RESISTOR, 45,3 OHM 1/4W 1% METAL FILM	3130453	7115
R0762	RESISTOR, 562 OHM 1/4W 1% METAL FILM	3135620	7115
R0763	POTENTIOMETER, 2,5K OHM 2W	3110329	44655
R0764	RESISTOR, 2320 OHM 1/4W 1% METAL FILM	3132321	7115
R0765	RESISTOR, 2700 OHM 1/4W 1% METAL FILM	3132701	7115
R0766	POTENTIOMETER, 250 OHM	3110145	71450
R0796	DIODE, 1N914	1520914	7910
R0800	RESISTOR, 2000 OHM 1/4W 5% CARBON	3070202	1121
R0806	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0807	RESISTOR, 274K OHM 1/4W 1% METAL FILM	3132743	7115
R0808	RESISTOR, 1000 OHM 1/4W 5% CARBON	3070102	1121
R0809	RESISTOR, 324K OHM 1/4W 1% METAL FILM	3133243	7115
R0810	RESISTOR, 332 OHM 1/4W 1% METAL FILM	3133320	7115
R0811	RESISTOR, 10000 OHM 1/4W 1% METAL FILM	3131002	7115
R0812	POTENTIOMETER, 5K OHM TRIM	3110149	71450
R0813	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0814	RESISTOR, 16500 OHM 1/4W 1% METAL FILM	3131652	7115
R0820	RESISTOR, 15K OHM 1/4W 5% CARBON	3070153	1121
R0821	RESISTOR, 11K OHM 1/4W 5% CARBON	3070113	1121
R0825	RESISTOR, 160 OHM 1/4W 5% CARBON	3070161	1121
R0826	RESISTOR, 4300 OHM 1/4W 5% CARBON	3070432	1121
R0827	RESISTOR, 360 OHM 1/4W 5% CARBON	3070361	1121
R0830	RESISTOR, 100K OHM 1/4W 5% CARBON	3070104	1121
R0831	RESISTOR, 5600 OHM 1/4W 5% CARBON	3070562	1121
R0835	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0836	RESISTOR, 51 OHM 1/4W 5% CARBON	3070510	1121
R0840	RESISTOR, 68 OHM 1/4W 5% CARBON	3070680	1121
R0841	RESISTOR, 10K OHM 1/4W 5% CARBON	3070103	1121
R0845	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0846	RESISTOR, 1580 OHM 1/4W 1% METAL FILM	3131581	7115
R0847	RESISTOR, 249 OHM 1/4W 1% METAL FILM	3132490	7115
R0848	POTENTIOMETER, 250 OHM	3110145	71450
R0850	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0855	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0860	RESISTOR, 10 OHM 1/4W 5% CARBON	3070100	1121
R0861	RESISTOR, 150 OHM 1/4W 1% METAL FILM	3131500	7115
R0862	RESISTOR, 26,1 OHM 1/4W 1% METAL FILM	3130261	7115
R0863	RESISTOR, 26,1 OHM 1/4W 1% METAL FILM	3130261	7115
R0864	RESISTOR, 34,8 OHM 1/4W 1% METAL FILM	3130348	7115
R0865	RESISTOR, 41,2 OHM 1/2W 1% METAL FILM	3100412	7115
R0866	RESISTOR, 41,2 OHM 1/2W 1% METAL FILM	3100412	7115
R0867	RESISTOR, 10,0 OHM 1/8W 1% METAL FILM	3100100	7115
R0868	RESISTOR, 46,4 OHM 1/2W 1% METAL FILM	3100464	7115
R0869	RESISTOR, 46,4 OHM 1/2W 1% METAL FILM	3100464	7115
R0870	RESISTOR, 3,16 OHM 1/8W 1% DEP, CARBON	3193160	7115
S0101	SWITCH, TOGGLE SPDT	2600103	100005
S0102	SWITCH, SLIDE	2600323	10597
S0200	CONCENTRIC SWITCH & POTENTIOMETER	2600313	71450
S0300	SWITCH, PUSH BUTTON	2600356	71590
S0350	SWITCH, SLIDE DPDT	2600212	76854
S0375	SWITCH, BCD ROTARY	2600324	10597
S0400	SWITCH, PUSH BUTTON	2600355	71590
S0600	SWITCH, ROTARY	2600357	76854
S0700	SWITCH, PUSH BUTTON	2600354	10597
T0100	TRANSFORMER, POWER	1200040	10597

SECTION 6

PARTS OVERLAY AND SCHEMATICS

FOREWORD TO SCHEMATICS

To facilitate quick reference to inter-connections from one schematic to another, a system of numbers has been utilized. Each schematic carries its own identifying number located in a large hexagonal shape near the title. When a connection is referred to, a small hex encompasses the number of the schematic that contains the connection.


HIGH FREQ ADJ
LOW FREQ ADJ
BEADS
SEARCH RANGE ADJ
-DRIVE ADJ
-CUR ADJ
1 SEC RESET ADJ
VCF ADJ
+CUR ADJ
+DRIVE ADJ
MULT ADJ
SQUARE DC
COM
FIXED OFF SINE ADJ
SQUARE AMP
PRE AMP BAL
SINE ADJ
TRI DC
TRI AMP
SINE SHAPER DC
1ST AMPL ADJ
2ND/2ND ADJ
2ND/3RD ADJ
2ND/4TH ADJ
3RD/1ST ADJ
3RD/2ND ADJ
3RD/3RD ADJ
3RD/4TH ADJ
PA BAL
SUM BAL AMP
PA GAIN
443-0174
6-16-72
XACT
+2.75V ADJ
-2.25V ADJ
CROW BAR
+15V ADJ
-15V ADJ
+20V ADJ
-20V ADJ

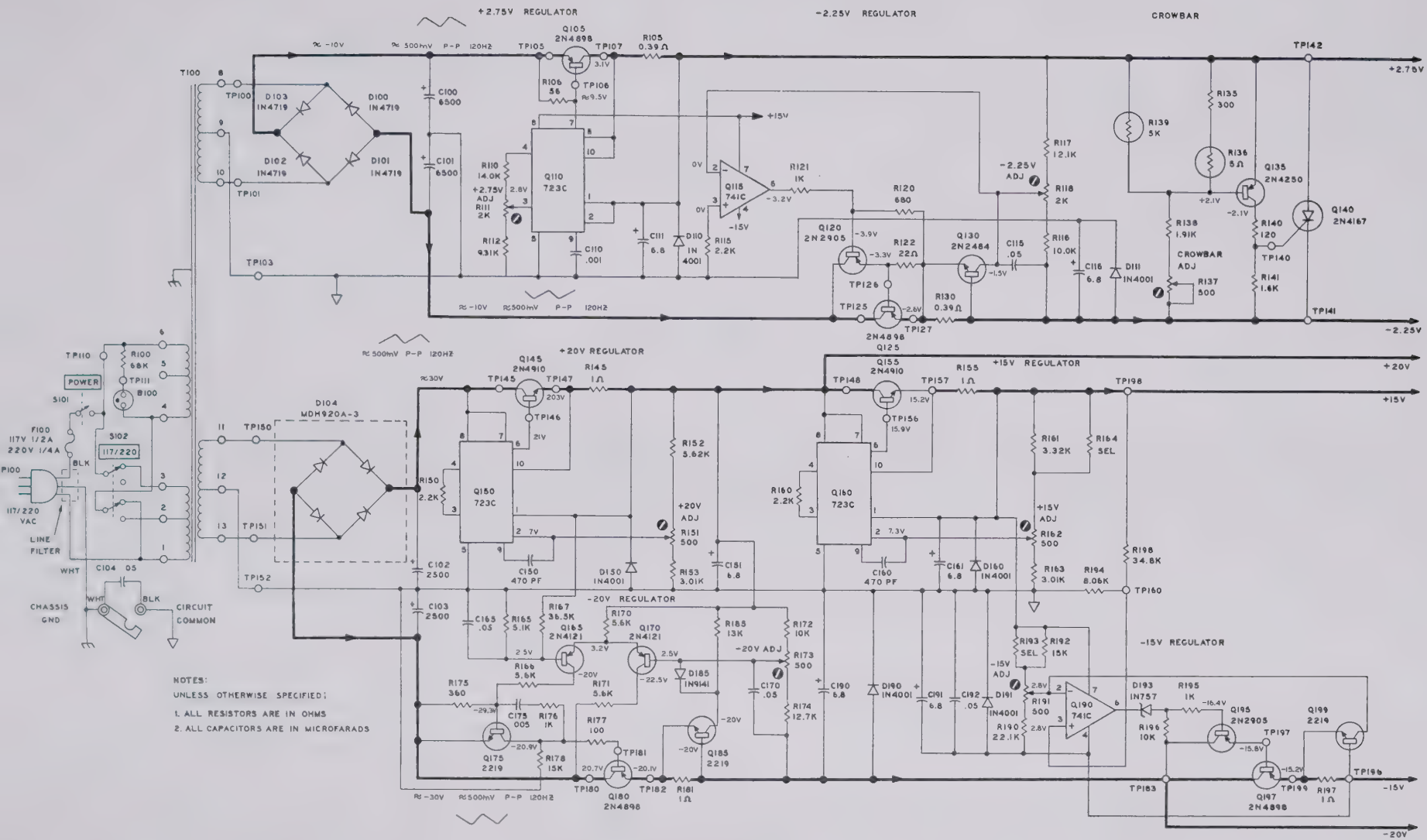
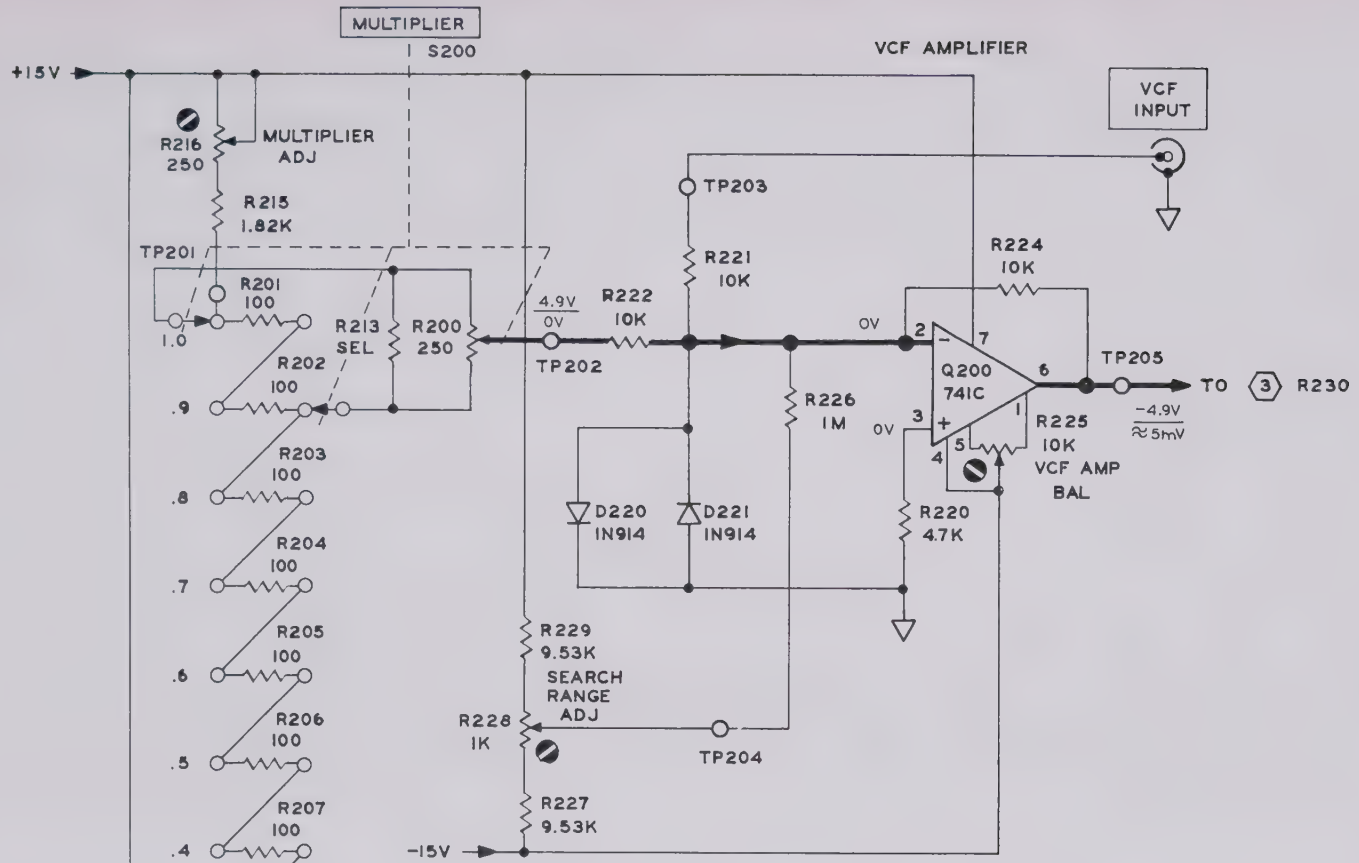
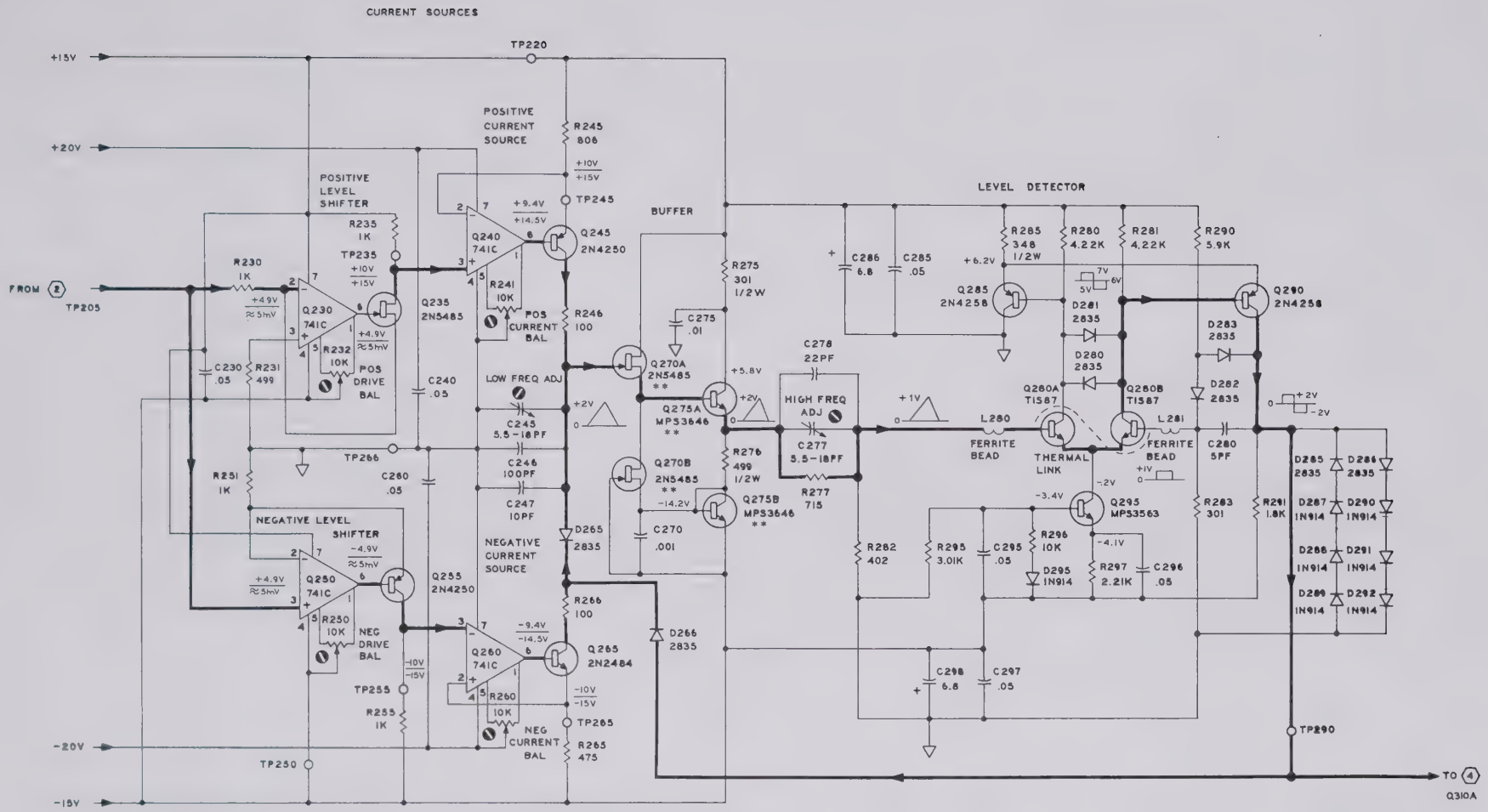


FIG 6.2
SCHEMATIC DIAGRAM MODEL 335
POWER SUPPLIES



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS IN OHMS

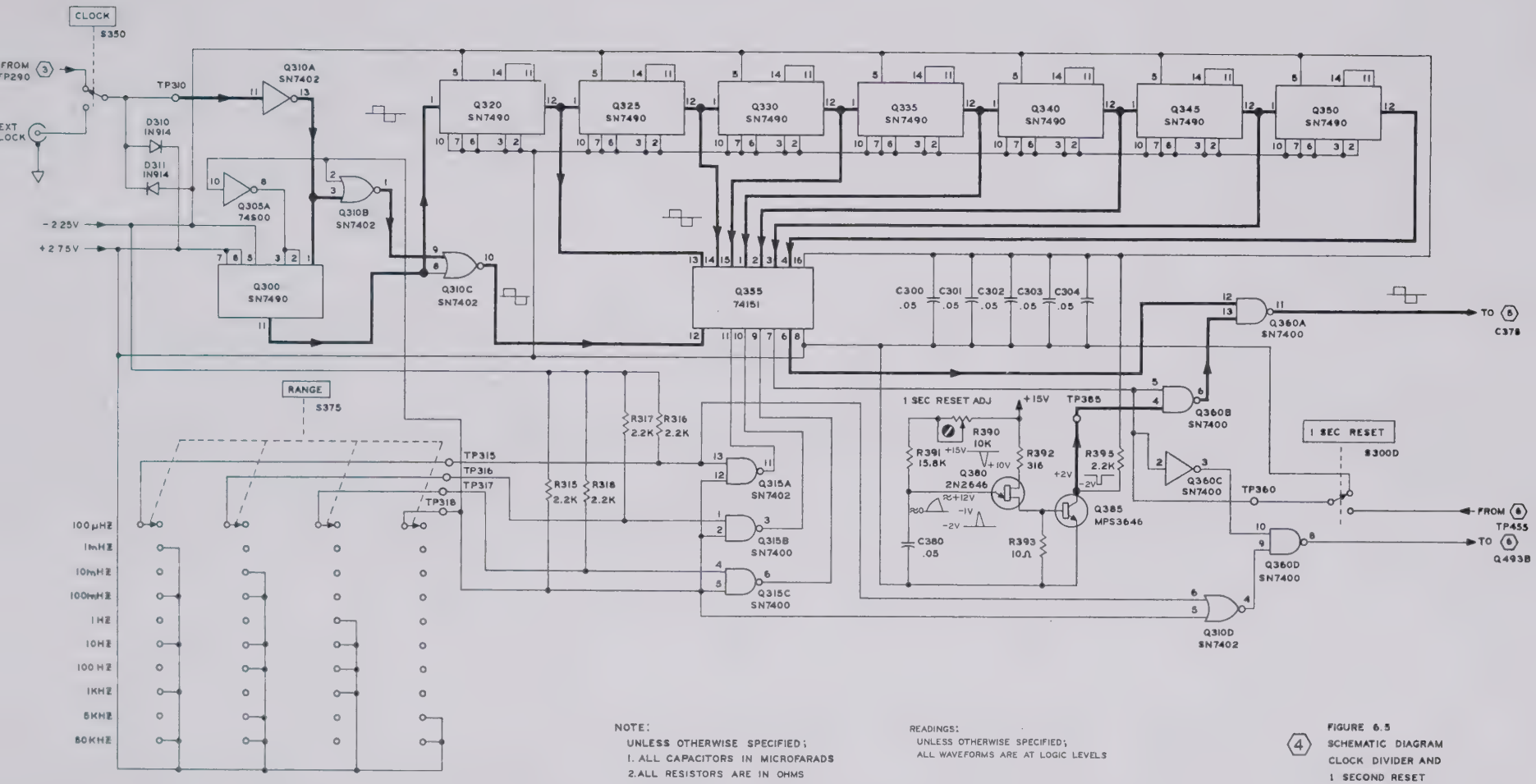
(2) FIGURE 6.3
SCHEMATIC DIAGRAM
FREQUENCY CONTROL



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MICROFARADS
3. ** MATCHED PAIR

READINGS:
TOP OF SEARCH
BOTTOM OF SEARCH

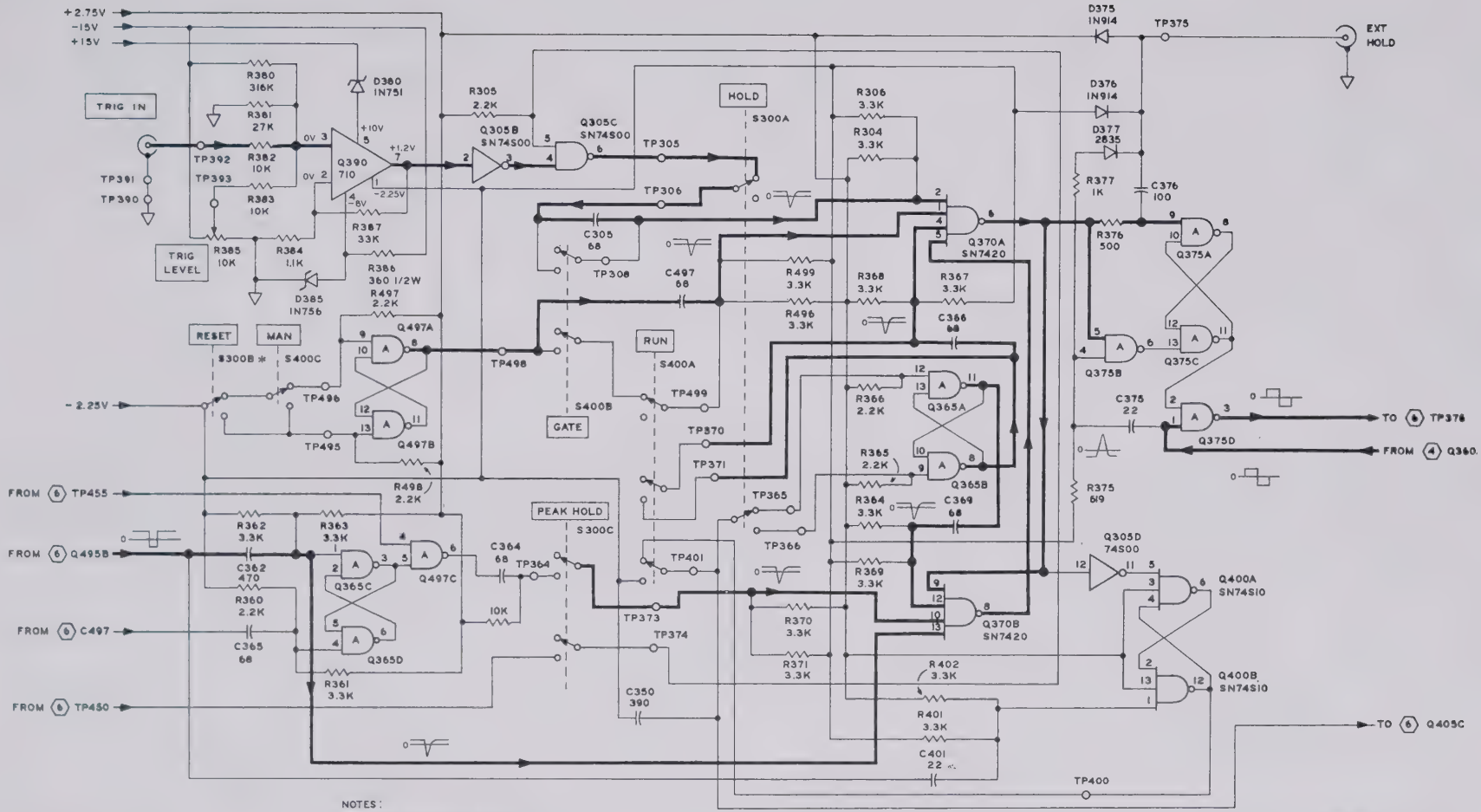
3 FIGURE 8.4
SCHEMATIC DIAGRAM
GENERATOR LOOP



NOTE:
UNLESS OTHERWISE SPECIFIED;
1. ALL CAPACITORS IN MICROFARADS
2. ALL RESISTORS ARE IN OHMS

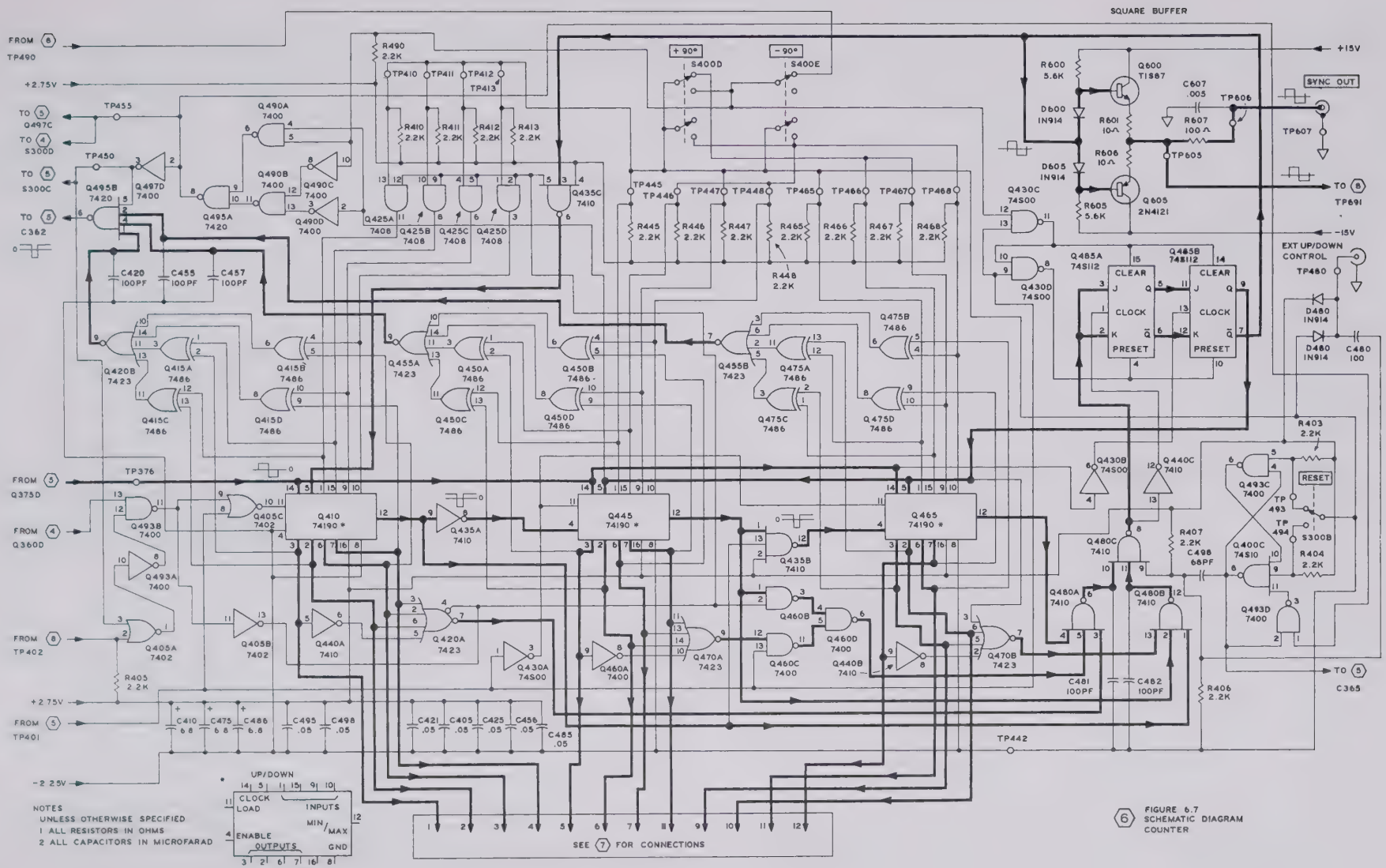
READINGS:
UNLESS OTHERWISE SPECIFIED;
ALL WAVEFORMS ARE AT LOGIC LEVELS

(4) FIGURE 6.5
SCHEMATIC DIAGRAM
CLOCK DIVIDER AND
1 SECOND RESET

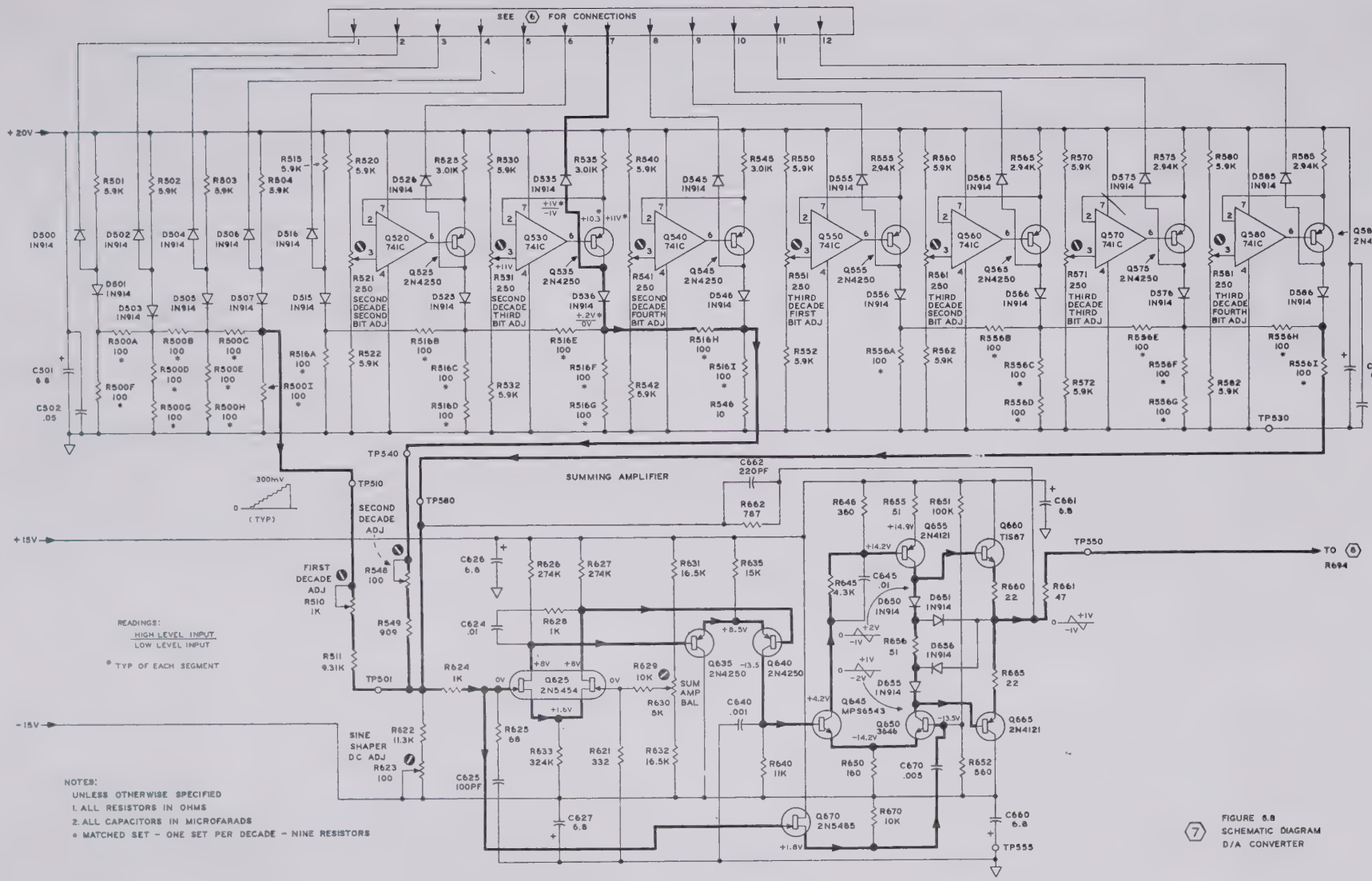


NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL CAPACITORS IN PICOFARADS
2. A = SN7400
3. * PART OF SWITCH ON SCHEMATIC (6)

(5) FIGURE 6.6
SCHEMATIC DIAGRAM
CLOCK CONTROL



6 FIGURE 6.7
SCHEMATIC DIAGRAM
COUNTER



(7) FIGURE 6.8
SCHEMATIC DIAGRAM
D/A CONVERTER

Ex Libris

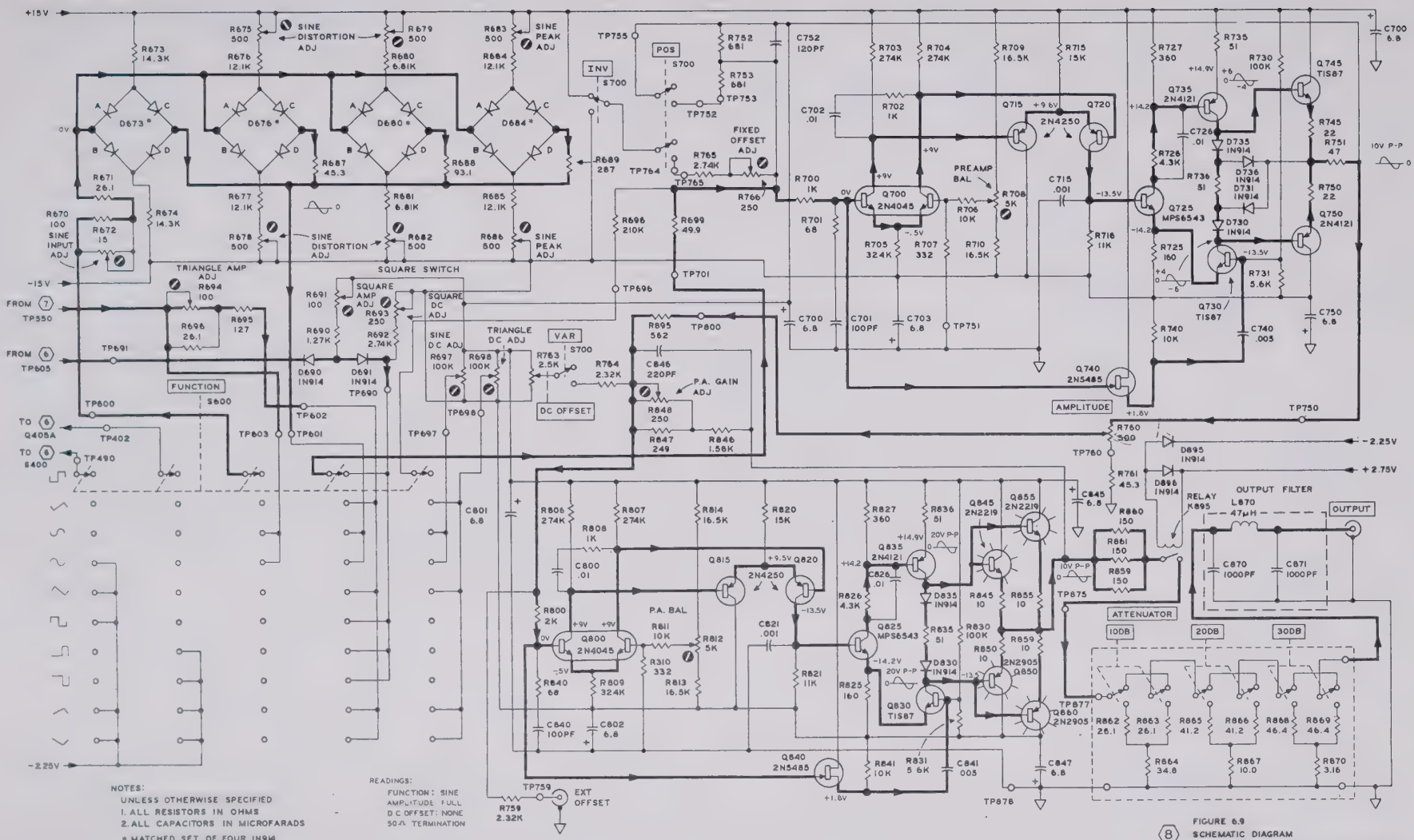


FIGURE 6.9
SCHEMATIC DIAGRAM
SIGNAL SHAPING AND POWER AMPLIFIER

SECTION 7

ADDENDA

At EXACT we continually strive to incorporate latest electronic developments by adding circuit and component improvements to our instrument line as they are developed and tested.

At times, due to printing and shipping requirements, change information is not entered in the main body of the manual. It therefore may contain new change information in the following pages of this section. If change pages do not appear in this section, your manual is correct as printed.

98835